RAVALLI COUNTY

1989 TRAFFIC

SAFETY STUDY

prepared by

MARVIN & ASSOCIATES

&

Stensatter Druyvestein & Assoc

RAVALLI COUNTY

TRAFFIC SAFETY IMPROVEMENT

STUDY

PREPARED BY

MARVIN & ASSOCIATES

1127 ALDERSON SUITE #204

BILLINGS, MT 59103

MONTANA * PROFESSIONAL ENGINEER * ROBERT R. MARVIN 3697E REGISTERED

Robert R. Marvin

AND

STENSATTER DRUYVESTEIN & ASSOC.

MISSOULA, MONTANA

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INTRODUCTION

STUDY PURPOSE

Ravalli County, in an effort to reduce or otherwise alleviate problems at accident cluster sites on the County Road System, has retained the Consulting Engineering Firm of Marvin & Associates to perform a traffic engineering study. The purpose of this study is to identify accident cluster locations, collect and analyze pertinent data, make short and long term safety improvement reccommendations and establish a priority list of improvement projects.

Other similar studies have been completed for Montana counties with the technical and fiscal assistance of the Montana Department of Justice, Highway Traffic Safety Division. The intent of the Highway Traffic Safety Division in sponsoring these studies is to first, reduce accidents on the county road systems and secondly, to establish an awareness of accident reduction measures so that a continuation of the program can be established within each county.

The methodology used in these studies, which primarily served as the basis for the analysis within this report, can be found in the report No. FHWA-RD-77-83 "Identification of Hazardous Locations. Refinements to the FHWA report made by DCA Project No. 79-04-01-01 and subsequent county studies throughout the state, are also incorporated within this report. The methodology used to establish priority rankings is explained in the Benefit/Cost Ratio section of this report and is tailored specifically to Ravalli County's unique requirements.

The implementation of traffic safety improvements contained within this report is presented differently than in some previous studies. Since the Montana Department of Highways (MDOH) has Off-system Safety funds available for use on some or all of the improvement projects recommended herein, the priorities and funding obligations are specifically tailored to MDOH requirements. Upon approval of this program by the county commission, this report should be submitted to the Department of Highways as justification for Off-system Safety fund allotments.

REPORT ORGANIZATION

The initial section of this report contains narratives describing the accident cluster site locations, characteristics of the county road system, study methodology, results of the hazard index analysis for all of the sites, explanation of the improvements recommended, priority index calculations, an implementation schedule and recommendations for continuation of the program in future years. **Special attention should be given to the Site Characteristics and Explanation of Improvements sections. Specific traffic safety information for the Ravalli County road system is presented in these sections.**

Site specific data can be found within the individual site sections following the main body of this report. A great deal of computer generated data was printed and reduced for inclusion on the existing condition and short term improvement sketches. The availability of pertinent data on the same page as the sketches

hopefully aids in comprehension of the problem identification and improvement benefits. The short term plan sketches can also be used by the Department of Highways to verify the traffic control device items eligible for funding through their program.

The site specific sections of this report are numbered according to their priority ranking as indicated in the site location section of this report. Only 10 sites are included in this project due to budget restrictions. Some of the sites were extensive in length and encompassed several localized cluster sites within them. For these particular sites, the recommendations are tied to improving individual sections with safety of the entire corridor in mind.

The basic organizational format of the site specific sections is as follows:

Narratives
* Location Description
* Existing Conditions
  - Geometrics
  - Traffic Control Devices
  - Traffic Volumes
  - Traffic Operations
  - Accidents
* Short & Long Term Improvements
* Benefits

Figures
~ Photos
~ Existing Condition Sketch
~ Short Term Improvement Sketch

SITE CHARACTERISTICS

SITE LOCATIONS

The maps contained at the end of this section (Figures 1.) show the ten accident sites and corridor areas respective to their priority numbers. Table 1., below, is a listing of site numbers corresponding to the site locations:

TABLE 1. LIST OF STUDY SITES

SITE PRIORITY I.D. NO.	LOCATION
1	SLEEPING CHILD ROAD - CURVES
2	SLEEPING CHILD ROAD - BEAR CR
3	OLD DARBY ROAD - COMO ROAD
4	AMBROSE ROAD
5	PLEASANT VIEW ROAD
6	OLD CORVALLIS ROAD - CURVES
7	QUAST LANE RXR
8	WILLOW CREEK ROAD RXR
9	OLD U.S. 93 - S OF MISS. CNTY
10	MIDDLE BURNT FORK ROAD

SYSTEM CHARACTERISTICS

Traffic Volumes - All of the accident sites are located in a rural environment and are on low volume roads. The highest traffic volume at any site is approximately 1,600 vehicles per day while the lowest volume is 110 vehicles per day or 110 ADT (Average Daily Traffic).

W.L. Higginbotham of the Ravalli County Road Department provided information on historical traffic volumes for various

county road sections. It should be noted that the County Road Department had just recently begun collecting traffic data and the oldest records were from 1988. The County's efforts in this regard are a positive step forward in planning and maintaining the fast growing road system. Since traffic volumes have been increasing at a 5-6% annual rate during the past nine years. Future records of this type will be invaluable.

The traffic volume counts provided by Ravalli County were recorded on machine counters. These counts were used to determine hourly traffic variations on various types of roads in Ravalli County. The hourly counts were graphed as a percentage of average daily traffic verses hour of the day. Four graphs typify a range of road types in Ravalli County. Figure 2. is the hourly traffic variation plots for Pleasant View Road, Sleeping Child Road, Ambrose Lane and Old Darby Road. Two of the roads, Sleeping Child and Old Darby, are typical of recreation type roads. The two remaining roads are typical of farm and residential access roads.

While evaluating the shape and peaking characteristics of the traffic volume curves, it was noted that these roads are not typical of most rural or urban roads. Some peak volumes occur before 5:00 PM, no distinctive peak occurs around noon and traffic in the late evening is much higher than what would be expected.

The Montana Department of Highways provided hourly counts at the Willow Creek Road site. These counts are also graphed in Figure 2. and they indicate a classic distribution of traffic throughout the day. In order to check traffic data variation, Marvin & Associates set out a counter on Pleasant View Road in

August. Figure 2. has a hourly traffic variation graph which shows the result of this count. The shape of this curve is not too different than the curve plotted from county data with the peak hours being very close. From this it could be assumed that the county data is valid. Individual manual counts were taken at the project sites. These counts did not match the County's records since the County's counts were taken at locations far removed from the sites. Volumes were very carefully adjusted by statistical methods for use in this report. Future use of the traffic volumes contained in this report should be verified if for purposes other than planning.

The evening peak hour, in most cases, is the highest volume percentage of any hour of the day and ranges from 6.0% to 11 % of average daily traffic. The morning peak hour is the second highest peak of the day in most cases, with 2% to 8% of average daily traffic.

Roadway Characteristics - The Ravalli County Road System contains roads typical of rural western Montana. Paved roads are found mostly in the valley while gravel roads are found in the foothills and mountains where residential and farming land uses are sparse. The County's major transportation needs are served by U.S. Route 93 which runs north-south from one end of the county to the other. Since mountain ranges parallel U.S. 93 and the major population lies in the valley, east-west routes are minor facilities. Routes parallel to U.S. 93 are limited in length except for the Eastside Highway, which is the only other major arterial in the county.

These arterials feel the brunt of any growth in the county. The county maintained road system has thus far alluded major problems caused by growth, because the system is rather fractured. Problems on the road system caused by growth are usually localized.

In all but four of the project sites, the roadway surface had some involvement with the accident experience. All of the gravel surface roads had at least one accident directly attributable to "washboard" conditions. In the case of Sleeping Child Road, at least seven accidents involved vehicles loosing control on washboard sections. Some of the paved roads also have ruts or raveled surfaces which tend to cause problems with vehicle dynamics and provide unexpected control situations for drivers.

Another of the most common problems observed at the study sites, involved condition of the roadside environment ie. sight distance restrictions caused by trees and brush or by machinery and buildings in the sight triangle. Trees should be trimmed at least 10 feet above the roadway and bushes should not exceed 3 feet in height to provide an unobstructed line of sight. In the forested section of roadway, clearing of trees is impractical, but critical obstructions could still be removed without a massive effort. Proper stopping and intersection sight distances for any individual section of road can be calculated by using the AAASHTO "Policy On Geometric Design for Highways and Streets", commonly known as the "Green Book".

In two cases, drainage structures located without respect to the flow of the roadway geometrics has caused severe operational problems because of the resulting misalignment. Historically,

bridges and culverts were installed to minimize construction costs without regard for the utility of the roadway. This approach to road building failed to recognize that these structures were only secondary to the function of the road. The true cost of these structures can now be realized in the accidents and operational problems they cause.

Two of the sites involve railroad crossings. There are numerous crossings on Ravalli County roads. While the number of vehicle-train accidents is not significant, accidents of this type tend to be severe. Because of the poor geometrics and restricted sight distance, railroad crossings in Ravalli County represent potentially serious problems for future safety as traffic volumes continue to increase.

Study Applications - From past experience, it has been discovered that the methods utilized in these type of studies provide quite different results when applied to an urban area as opposed to rural country roads. In this case, the application of study methods is ideally suited to the rural road system in Ravalli County. Even considering this fact, the highest priority sites were on the most rural, low volume sections of roadway. This situation should be expected, since cluster sites on low volume roads have a higher accident rate; speeds are higher and thus severity is usually greater; and the cost of making significant improvements is usually less. Since the site selection process for this study was based on statistical indicators based on these factors, the low volume rural roads usually ranked high.

Traffic Control Devices - Some degree of traffic control devices were present at almost all of the sites. However, none of the sites had control devices that were completely adequate for the conditions encountered. Some sites were signed more than others, probably because of complaints or because of the knowledge of past problems. The sites, for the most part, were typical of all Ravalli County roads as far as traffic control device applications. Warning and guide signs are used sparingly on most of the road system. Pavement markings are all but nonexistent on county roads along with roadside delineation.

It is evident that Ravalli County has expended some effort to correct roadway deficiencies with the use of traffic control devices. In some areas, signing is applied conservatively while others have no signing. This is understandable, considering the limited budget of county governments. This study recommends a high degree of signing and pavement marking application at the study sites. Since consistency of signing and pavement marking is extremely important, Ravalli County should plan on revising the applications and locations of signs and pavement markings on all county roads after these improvements are implemented. This work should be considered a long range goal of the county, since the needs are great and the funds are limited. Standard traffic control devices applied consistently will aid in the future elimination of accidents county wide.

Traffic Accidents - Traffic accident characteristics for all of

the Ravalli County sites are summarized below:

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------------------------------------------------------------------------------
                  ACCIDENT STATISTICS -       ALL RAVALLI COUNTY SITES
------------------------------------------------------------------------------
ACCIDENTS / YEAR :                            ROAD CONDITIONS - % OF TOTAL :
   1985  =  18                             42 DRY  =          64%
   1986  =  13                              6 WET  =           9%
   1987  =  19                             18 ICY  =          27%
   1988  =  16 TOTAL =   66                   LIGHT CONDITIONS - % OF TOTAL :
ACCIDENT TYPE - % OF TOTAL :               36 DARK =          55%
 5 HEAD ON   =         8%                  30 DAY  =          45%
 3 ANGLE     =         5%
 0 LEFT TURN=          0%                     SEVERITY - % OF TOTAL :
 0 SIDE SWP.=          0%                   1 FATAL    =        2%
 2 REAR END =          3%                  30 INJURY   =       45%
52 SINGLE V =         79%                  35 PROP DAM=        53%
 4 OTHER    =          6%
WEATHER CONDITIONS - % OF TOTAL :                      ALCOHOL        19
57 CLEAR =            86%                              INVOLVED
 4 RAIN  =             6%                              % TOTAL =      29%
 5 SNOW  =             8%
 0 FOG   =             0%
------------------------------------------------------------------------------
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Of all the years in this period, 1986 had the least number of accidents. The predominance of rural sites is evident in the statistics, since they are primarily single vehicle accidents. Most of the accidents occurred in clear weather on dry roads. Night time accidents were more common than daytime accidents and property damage accidents outweighed injury accidents. One fatal accident occurred within the study sites. Alcohol involvement played only a minor role, since only 29% of the accidents involved drivers who had been drinking.

Future System Characteristics - Ravalli County does not have a formal transportation plan. It can be assumed, from conversations with MDOH and County officials, that Ravalli County is a fast

growing area and demand for improved transportation facilities will continue to grow. Since the exact areas of growth and the resultant impacts at the study sites are not known, any long term improvements suggested within this report are based solely on existing traffic conditions. Long term solution are merely alternative improvements involving a higher level of safety with a commensurate degree of funding requirements.

STUDY METHODOLOGY

The study was segregated into four distinct phases which best achieved the purpose and scope of the traffic study. These phases are outlined as follows:

Phase 1 - Site Selection Phase; involved copying all of the accident reports on Ravalli County roads for the years 1985 thru 1988 from Department of Justice files in Helena, Montana. These reports were first arranged alphabetically and separated according to road names. Reports on each individual road were screened for location by intersecting roadway and cross referenced. Finally, the reports were plotted on county grid maps to identify cluster areas. All identified clusters having less than three accidents during the reporting period were discarded. The remaining accidents were entered into a computer program to calculate preliminary hazard index values.

Number of accidents, accident rates and severity indexes were calculated for forty cluster sites. Table 2. is a summary of the

TABLE 2. RAVALLI COUNTY ACCIDENT CLUSTER SITE SELECTION MATRIX - PRELIMINARY

SITE NO.	MAJOR ROUTE	INTERSECTION OR LOCATION	ACCIDENTS / YEAR 85	86	87	88	TOTAL NO. ACC.	NO. ACC. INDEX	APPROX. VOLUME	ACC. RATE	ACC. RATE INDEX	SVRTY INDEX	COMPOSITE SCREEN INDEX	REMARKS
1	SLEEPING CHILD ROAD	AT BEAR CREEK	2	0	0	4	6	54	600	6.85	99	56	72.2	RECOMMENDED SITE
2	BOWMAN ROAD	US 93 INTER. AREA	2	2	3	2	9	64	900	6.85	99	43	71.0	" "
3	SLEEPING CHILD ROAD	6-7.2 MI S SKALKAH	6	2	2	1	11	69	1200	6.28	94	44	70.6	" "
4	AMBROSE CREEK ROAD	1.2-2.5 MI E S 203	1	3	3	2	9	64	1200	5.14	83	52	67.6	" "
5	OLD DARBY ROAD	COMO RD INTER AREA	1	4	5	5	15	78	2200	4.67	78	46	67.4	" "
6	OLD CORVALLIS RD	CURVES .5 W RIVERS	2	1	3	0	6	54	800	5.14	83	45	62.5	" "
7	OLD US 93	.2-.8 MI MISS CNTY	2	1	3	0	6	54	800	5.14	83	45	62.5	" "
8	PLEASANT VIEW RD	.4 MI MIDDLE BEAR	3	1	0	2	6	54	800	5.14	83	45	62.5	" "
9	MIDDLE BURNT FORK	N.BURNT FORK-.5 MI	2	2	2	0	6	54	800	5.14	83	40	60.8	" "
10	QUAST LANE	RAILROAD X-ING	1	0	0	1	2	33	250	5.48	87	45	58.0	" "
11	DUTCH HILL RD	.7-1.2 MI W US 93	1	4	1	1	7	58	1200	4.00	70	43	57.8	ALTERNATIVE SITE
12	CANYON CREEK RD	CURVES .5MI S BLOD	0	2	1	1	4	45	600	4.57	77	45	57.6	" "
13	TAMMANY LOOP	1-1.2 MI E AIRPORT	1	2	0	1	4	45	700	3.91	69	45	54.6	" "
14	BOWMAN ROAD	1.2-1.8 MI W US 93	1	1	2	1	5	50	1000	3.42	63	48	54.3	" "
15	RYE CREEK ROAD	CURVE 3.8 MI E US	0	1	1	3	5	50	800	4.28	74	35	54.1	" "
16	DALY AVENUE	.1-.3 MI S FAS 269	2	2	1	0	5	50	1000	3.42	63	42	52.4	" "
17	WILLOW CREEK RD	WILLOW CR X-ING RD	2	0	0	1	3	40	500	4.11	72	40	52.2	" "
18	OLD DARBY ROAD	1-1.8 MI N DARBY	1	2	0	1	4	45	800	3.42	63	45	52.1	" "
19	RYE CREEK ROAD	2-2.5 MI E US 93	0	0	0	4	4	45	800	3.42	63	45	52.1	" "
20	BASS LANE	.5 MI EAST FAS 269	1	2	0	0	3	40	400	5.14	83	22	51.1	" "
21	SALISH TRAIL	SILVERTHORN INTERS	1	0	1	1	3	40	600	3.42	63	40	48.8	" "
22	RICKETTS ROAD	.5 MI S CANYON CR	1	1	2	2	6	54	1200	3.42	63	22	47.1	" "
23	MIDDLE BURNT FORK	LOGAN INTERSECTION	0	2	1	1	4	45	1200	2.28	46	45	45.6	" "
24	MIDDLE BURNT FORK	1.3 MI E OF LOGAN	2	1	0	0	3	40	900	2.28	46	49	45.5	" "
25	CORVALLIS MAIN ST	1ST - 2ND STREETS	4	0	1	1	6	54	1800	2.28	46	33	44.1	" "
26	MERIDIAN ROAD	1-2 MI S VICTOR	1	0	2	2	5	50	1800	1.90	40	42	43.5	" "
27	OLD US 93	.2 MI N FLORENCE	1	2	0	0	3	40	900	2.28	46	40	42.3	" "
28	SKALKAHO ROAD	SLEEPING CHILD INT	2	0	0	2	4	45	2000	1.37	31	52	41.9	" "
29	GRANTSDALE ROAD	BLOOD LANE INTER	2	1	0	1	4	45	1400	1.96	41	37	40.7	" "
30	RICKETTS ROAD	BLODGETT INTER	5	0	0	0	5	50	1200	2.85	55	16	40.6	" "
31	DUTCH HILL RD	CHERRY O TO .5 WES	1	1	1	2	5	50	1400	2.45	49	22	40.5	" "
32	VICTOR MAIN STREET	MERIDIAN INTERSECT	0	2	0	2	4	45	1500	1.83	39	37	39.9	" "
33	GRANTSDALE ROAD	GOLF CRSE RD INTER	2	1	2	0	5	50	2200	1.56	34	35	38.6	" "
34	DORAN STREET	.4-.6 MI S GOLF CR	0	2	0	1	3	40	1200	1.71	37	40	38.6	" "
35	VICTOR CROSSING RD	.5-1.7 MI E US 93	1	0	0	3	4	45	2200	1.25	28	45	38.6	" "
36	GRANTSDALE ROAD	FISH HATCH RD INTE	2	2	0	0	4	45	2500	1.10	25	45	37.5	" "
37	FAIRGROUNDS ROAD	FAS 269 TO .3 MI E	1	0	2	2	5	50	2500	1.37	31	35	37.3	" "
38	SHEAFMAN ROAD	MERIDIAN INTERSECT	1	0	1	1	3	40	1500	1.37	31	40	36.2	" "
39	AMBROSE CREEK ROAD	.5 MI EAST FAS 203	0	0	3	0	3	40	1000	2.05	42	22	35.2	" "
40	HAMILTON HEIGHTS	EASTSIDE HWY-.3 MI	1	1	1	0	3	40	3000	0.68	17	40	30.9	" "
		TOTALS =	59	48	44	51	202							
		AVE. YEAR =	1.5	1.2	1.1	1.3	1.3	49.0	1233.8	3.4	59.5	40.2	50.2	

screening program. The cluster sites were ranked according to the composite value of the three indexes. A recommended list of sites was sent to Ravalli County for their approval. The list was modified due to overlapping jurisdiction and other valid reasons and the final list of sites was approved.

Phase 2 -Data Collection Phase; included preliminary organization of the project including scheduling, site location, form processing, field data collection and reduction of data. Accident data was obtained from reports provided by the Department of Justice. Traffic counts were taken at each location. The existing average daily traffic was determined by applying factors for hourly, daily and monthly variations. Historical traffic volumes were provided by Ravalli County.

Other data collected in the field included measurement of road widths and geometrics, and inventory of traffic control devices, turning movement counts and subjective observation of traffic operations. Aerial photographs were used to develop horizontal alignment.

Phase 3 - Analysis of Data; included the determination of hazard indexes for each location by using the Federal Highway Administration Report No. FHWA-RD-77-83 "Identification of Hazardous Locations". Computations involved with accidents, volumes, capacities, indicator values and other aspects of hazard indexes were performed on the microcomputer. From these computations a preliminary hazard ranking list was prepared.

Phase 4 - Evaluation of Corrective Measures and Priority Listing; included the determination of improvements that would reduce or eliminate certain types of accidents in general at the study locations. Preliminary designs of those improvements included signing, geometric changes, and reconstruction. The improvements were recommended on a short term basis. In most cases, the nature of the sites was such that long term improvements could not be recommended.

Cost effectiveness calculations of the improvements at each location were determined by preparing preliminary cost estimates and computing economic benefits to arrive at a benefit/cost ratio. The method used to determine benefit/cost ratios is identical to that used by the Montana Department of Highways Project Planning Section. All values used in the formulation were supplied by Hank Butzlaff, supervisor of that section. The composite hazard index ranking and benefit/cost ratio, then determined the final priority listing.

ERROR ANALYSIS

The analysis of high hazard accident sites by the methods published in FHWA Report No. FHWA-RD-77-83 intrinsically contains some degree of error due to subjective data collection and computational bias. In the application of the method, certain other innate errors appear in various forms.
A cursory analysis of these error sources and the relative degree

of effect each has on the final index ranking is represented in this section.

SITE SELECTION

Site selection involved the use of the three major indexes used in the computation of hazard indexes. Therefore, the possible error of not selecting the most hazardous sites in the county was greatly reduced.

NUMBER OF ACCIDENTS INDICATOR

The average number of accidents per site was 6.6 which would result in an average indicator value of 54. Assuming the worst conditions for error analysis purposes, two reports may be incorrect either by misplaced location or lost, which would produce negative bias. This would result in a negative bias of 10%.

ACCIDENT RATE INDICATOR

Since volume data for the exact period of accident reporting may not exist at some locations, factors adjusting past or present Average Daily Traffic (ADT) to the analysis period were used. Assuming the worst cases of no growth or double growth, the actual ADT during the reporting period would have created a negative or positive bias of 6% in the indicator value.

The volume capacity indicator would present a similar bias of lessor magnitude due to ADT factoring.

HAZARD INDEX ERROR

Based on the foregoing assumptions, the average error in the hazard index of 62.0 could be negative or positive. It is unlikely that all bias would be directed in a positive or negative direction. It is most probable that compensating errors occurred in the majority of instances.

HAZARD INDEX - ANALYSIS RESULTS

Seven hazard indexes were used as the preliminary basis of ranking hazardous sites. The following are brief descriptions of each index including data format, data collection, indicator scaling and site ranking with respect to each index.

1. **Number of Accidents** - This indicator provides a historical background of accidents at the investigation site. In the case of Ravalli County, a four year period was used, which included 1985 - 1988. The accident reports were photo copied in Helena and provided to the consultant. The data represents all reports filed on county roads in Ravalli County.

Figure 3. is a curve extracted from the FHWA report which is used to determine the indicator value. The data base is number of accidents per year. This indicator as all of the seven indicators used in the report is scaled between 0 and 100. An average of two accidents per year in a three year period indicates a hazardous location (indicator value of 33). Ten accidents on the average per year is used to designate a very hazardous location (indicator value of 67). In the case of this study where low volume roads are involved, the total accidents number of accidents per site criteria was used to extract the index value. This higher value is therefore more consistent with the level of the the other index values. Using an annual rate would scale down the importance of this indicator relative to other index values.

Table 3 is the computer generated ranking of all sites based on this indicator.

TABLE 3. SITE RANKING BY NUMBER OF ACCIDENTS

RANK NO.	MAJOR ROUTE	ACCIDENTS / YEAR 85	86	87	88	TOTAL NO. ACC.	NO. ACC. INDEX
1	OLD DARBY ROAD - COMO ROAD	0	2	5	5	12	72
2	SLEEPING CHILD ROAD - CURVES	6	3	2	1	12	72
3	AMBROSE ROAD	1	3	3	2	9	64
4	OLD CORVALLIS ROAD - CURVES	2	1	3	0	6	54
5	MIDDLE BURNT FORK ROAD	2	2	2	0	6	54
6	SLEEPING CHILD ROAD - BEAR CR	2	0	0	4	6	54
7	OLD U.S. 93 - S OF MISS. CNTY	1	1	3	0	5	50
8	PLEASANT VIEW ROAD	2	1	0	2	5	50
9	WILLOW CREEK ROAD RXR	1	0	1	1	3	40
10	QUAST LANE RXR	1	0	0	1	2	33
	TOTALS =	18	13	19	16	66	
	AVERAGES =	1.8	1.3	1.9	1.6	6.6	54

2. **Accident Rate Indicator** - This indicator somewhat compensates for any incomplete information provided by the number of accident indicators, in that an exposure value is provided by the relationship between accidents and the total volumes of vehicles using the facility.

The data base for this indicator is expressed as the number of accidents per million entering vehicles. In the case of an intersection, "million entering vehicles" is the sum of the daily average approach volumes on all legs of the intersection, multiplied by the number of days in the analysis period.

The accident rate indicator is a very important part of the hazard index ranking method and data collection is possible only when a continued program of traffic counting has been performed.

Spot counts adjusted by yearly volume increases, seasonal variations, daily variations and hourly variations were necessary at most of the sites to develop an average daily traffic figure applied to the analysis period. The length of the cluster areas was extremely variable in this study. If the volumes were applied on a per site basis, the bias would be toward the longer sections. Therefore, the indicator was used by calculating number of accidents per million vehicles per 0.2 mile sections.

Figure 4 represents the graphic plot of accident rate versus indicator value. As before, the indicator value ranges between 0 and 100.

Table 4 is the computer generated ranking of sites based on this indicator.

TABLE 4. SITE RANKING BY ACCIDENT RATE

RANK NO.	INTERSECTION LOCATION	TOTAL ACCIDENTS 4 YEARS	1989 ADT	4 YEAR PERIOD AVERAGE	ACCIDENTS PER MVE	ACC RATE IND VAL
1	SLEEPING CHILD ROAD - BEAR CR	6	110	110	24.91	100
2	SLEEPING CHILD ROAD - CURVES	12	110	110	18.68	100
3	OLD DARBY ROAD - COMO ROAD	12	240	240	5.71	89
4	QUAST LANE RXR	2	290	270	5.07	83
5	MIDDLE BURNT FORK ROAD	6	300	288	2.85	55
6	WILLOW CREEK ROAD RXR	3	970	892	2.30	46
7	OLD U.S. 93 - S OF MISS. CNTY	5	870	800	1.71	37
8	AMBROSE ROAD	9	690	635	1.62	35
9	PLEASANT VIEW ROAD	5	460	423	1.62	35
10	OLD CORVALLIS ROAD - CURVES	6	1,660	1,527	0.90	21
	AVERAGE VALUES =	7	570	530	7	100

3. Accident Severity Indicator - Although there are many factors involved in the severity of accidents, statistical studies over a significant number of years have given fairly reliable dollar values in terms of economic loss for each type of accident. The accident severity indicator correlates a probable cause and effect relationship which aids in the determination of the level of accident reduction measures required. Severity values can also be used as a determinant of benefits resulting from various improvements.

The data base for accident severity is average relative severity in thousands of dollars. Data collection necessary for the use of the severity index is made possible by the accident report form. Dollar values for severity were provided by Hank Butzlaff of the Montana Department of Highways. They are: Fatal Accident = $500,000, Injury Accident = $11,000 and Property Damage Accident = $1,500.

The FHWA report presents the relative severity index values for each type of accident. Once the type of accident has been established, Figure 5 enables the user to assess the indicator value. Figure 5 is a graphic plot of the average severity in thousands of dollars versus the indicator value which is based on a scale of 0 to 100.

Table 5 is the computer generated ranking of sites based on this indicator.

TABLE 5. SITE RANKING BY ACCIDENT SEVERITY

RANK NO.	INTERSECTION LOCATION	SUM OF SEVERITY VALUES	TOTAL NO. ACC.	AVERAGE SEVERITY INDEX	INDICATOR VALUE
1	SLEEPING CHILD ROAD - BEAR CR	$507,500	6	$84,583	100
2	AMBROSE CREEK ROAD	$80,000	9	$8,889	62
3	WILLOW CREEK ROAD RXR	$23,500	3	$7,833	59
4	PLEASANT VIEW ROAD	$36,000	5	$7,200	57
5	OLD CORVALLIS ROAD - CURVES	$37,500	6	$6,250	54
6	QUAST LANE RXR	$12,500	2	$6,250	54
7	SLEEPING CHILD ROAD - CURVES	$75,000	12	$6,250	54
8	OLD DARBY ROAD - COMO ROAD	$65,500	12	$5,458	51
9	OLD U.S. 93 - S OF MISS. CNTY	$26,500	5	$5,300	50
10	MIDDLE BURNT FORK ROAD	$18,500	6	$3,083	41
	TOTAL SEVERITY $ =	$882,500			
	TOTAL NO. ACC. =		66		
	AVE. SEVERITY / ACC. =			$13,371	
	AVE. IND. VAL / SITE =				58

4. Volume to Capacity Ratio Indicator - This indicator not only produces exposure rates but also incorporates existing roadside features and conditions such as traffic type, turning directions, volume mix and number of lanes.

Computation of the volume capacity indicator is expressed as follows:

$$V/C = ADT/24 \text{ HOUR CAPACITY}$$

Again the low volume nature of these sites would dilute the relative importance of this indicator if calculated in this manner. Therefore, volume/capacity calculation using the 1985 Highway Capacity Manual procedures were used and expressed as a peak hour V/C. If the above formula were used, the maximum index value would have been less than 10 and more than half of the sites would have been at or near zero.

Data required for the volume capacity ratio involves field measurements of existing geometrics, turning counts and volume mix. The capacity of each section of road or intersection is computed through methodology presented in the 1985 Highway Capacity Manual using FHWA computer software. Although this indicator is cumbersome to use by inexperienced personnel, its inclusion is considered necessary and correlates well in hazardous index ranking.

Figure 6. presents a graphic plot of the volume capacity ratio versus the indicator value which is also scaled between 0 and 100.

Table 6. is the computer generated ranking of the sites based on this indicator.

TABLE 6. SITE RANKING BY VOLUME/CAPACITY RATIOS

RANK NO.	INTERSECTION LOCATION	PEAK HOUR CAPACITY	PEAK HOUR FLOW	V/C RATIO	V/C INDICATOR VALUE
1	OLD CORVALLIS ROAD - CURVES	621	166	0.27	50
2	WILLOW CREEK ROAD RXR	449	97	0.22	43
3	PLEASANT VIEW ROAD	265	51	0.19	40
4	OLD U.S. 93 - S OF MISS. CNTY	666	87	0.13	30
5	AMBROSE ROAD	600	69	0.12	28
6	OLD DARBY ROAD - COMO ROAD	305	24	0.08	21
7	QUAST LANE RXR	372	29	0.08	21
8	MIDDLE BURNT FORK ROAD	404	26	0.06	18
9	SLEEPING CHILD ROAD - BEAR CR	359	11	0.03	11
10	SLEEPING CHILD ROAD - CURVES	359	11	0.03	11
	AVERAGE VALUES	440	57	0	27

5. Sight Distance Indicator - This indicator is of significant value in rural locations, especially at intersecting roads. Even though the weighting factor in the hazard index computation is low, it is still considered valuable in determining deficiencies on unimproved county roads.

The data format for using the sight distance indicator is the ratio of actual sight distance to desirable sight distance. The FHWA report presents the minimum stopping sight distance on wet pavement for the various design speeds. Actual stopping sight distance is the distance from the drivers position to the point where a stop may be required to avoid a hazardous maneuver or direct collision.

The data format for this indicator is the sight distance ratio of actual over desirable. Collection of the sight distance data requires field measurements of sight distance and determination of average travel speeds. Figure 7. presents a graphic plot of the sight distance ratio versus the indicator value which ranges from 0 to 100.

Table 7. is the computer generated ranking of sites based on this indicator.

TABLE 7. SITE RANKING BY SIGHT DISTANCE

RANK NUMBER	INTERSECTION LOCATION	N SD	REQ SD	RATIO	IND VAL	S SD	REQ SD	RATIO	IND VAL	E SD	REQ SD	RATIO	IND VAL	W SD	REQ SD	RATIO	IND VAL	*WT. IND VAL
1	OLD DARBY ROAD - COMO ROAD	125	250	0.50	100	125	250	0.50	100	400	500	0.80	56					100
2	SLEEPING CHILD ROAD - BEAR CR	100	250	0.40	100	100	250	0.40	100									100
3	PLEASANT VIEW ROAD	250	400	0.63	82	225	400	0.56	96									91
4	SLEEPING CHILD ROAD - CURVES	150	250	0.60	88	150	250	0.60	88									88
5	MIDDLE BURNT FORK ROAD	350	400	0.88	47	300	400	0.75	62					300	650	0.46	100	87
6	AMBROSE ROAD	500	550	0.91	44	250	550	0.45	100	400	275	1.45	13	400	275	1.45	13	81
7	WILLOW CREEK ROAD RXR	300	550	0.55	100	800	550	1.45	13	500	275	1.82	2	400	275	1.45	13	71
8	OLD U.S. 93 - S OF MISS. CNTY	500	400	1.25	21	500	400	1.25	21	400	650	0.62	84					63
9	OLD CORVALLIS ROAD - CURVES	250	275	0.91	44	400	275	1.45	13	300	275	1.09	30	200	275	0.73	65	58
10	QUAST LANE RXR	400	550	0.73	65	500	550	0.91	44	800	400	2.00	2	800	400	2.00	0	58

AVERAGE INDICATOR VALUE = 79.8

6. **Driver Expectancy Indicator** - This indicator relates human behavior factors to existing road conditions. The value of this indicator is realized in the fact that the roadway geometrics and roadside culture are evaluated on a human judgement basis.

The data format for the driver expectancy index is the problem rating scale. Being a subjective indicator, the degree of expectancy is rated on a scale from 1 to 6, and the expectancy rating varies linearly with the indicator value as shown in Figure 8. The expectancy rating form can be found in the FHWA report for further reference.

Table 8. is the computer generated ranking of sites based on this indicator.

TABLE 8. SITE RANKING BY DRIVER EXPECTANCY

RANK NO.	INTERSECTION LOCATION	NB RATE	SB RATE	EB RATE	WB RATE	WGTD. RATE	IND VAL
1	AMBROSE CREEK ROAD			6	6	6.0	100
2	PLEASANT VIEW ROAD			5	6	5.5	92
3	WILLOW CREEK ROAD RXR			6	5	5.5	92
4	QUAST LANE RXR			6	4	5.0	83
5	SLEEPING CHILD ROAD - BEAR CR	3	6			4.5	75
6	MIDDLE BURNT FORK ROAD			5	4	4.5	75
7	OLD DARBY ROAD - COMO ROAD	6	4	3		4.3	72
8	OLD CORVALLIS ROAD - CURVES	4	4			4.0	67
9	SLEEPING CHILD ROAD - CURVES			5	3	4.0	67
10	OLD U.S. 93 - S OF MISS. CNTY	2	4			3.0	50

AVERAGE INDICATOR VALUE = 77.2

7. **Information System Deficiencies Indicator** - This indicator also provides a value or subjective judgement on the sufficiency of traffic control devices which transfer necessary information to the operator.

The data format for the information system deficiencies indicator is similar to that of the driver expectancy indicator in that a value form is used to provide a rating between 1 and 6. The rating for this indicator is also plotted linearly between the indicator range values of 0 and 100 and is shown on Figure 9. The value rating form is for the information system deficiencies indicator. It is also presented in the FHWA report for further reference.

Table 9. is the computer generated ranking of sites based on this indicator.

TABLE 9. SITE RANKING BY INFORMATION DEFICIENCY

RANK NO.	INTERSECTION LOCATION	NB RATE	SB RATE	EB RATE	WB RATE	WGTD. RATE	IND VAL
1	PLEASANT VIEW ROAD			6	6	6.0	100
2	SLEEPING CHILD ROAD - BEAR CR	6	6			6.0	100
3	SLEEPING CHILD ROAD - CURVES			6	4	5.0	83
4	AMBROSE CREEK ROAD			5	5	5.0	83
5	QUAST LANE RXR			5	5	5.0	83
6	OLD DARBY ROAD - COMO ROAD	6	5	4		5.0	83
7	WILLOW CREEK ROAD RXR			5	4	4.5	75
8	OLD U.S. 93 - S OF MISS. CNTY	4	4			4.0	67
9	MIDDLE BURNT FORK ROAD			4	3	3.5	58
10	OLD CORVALLIS ROAD - CURVES	4	3			3.5	58

AVERAGE INDICATOR VALUE = 79.2

HAZARD RANKING

Once all of the data had been collected and the indicator values computed, indicator values and necessary data were transferred to the hazard index computation matrix. Each indicator is weighted in accordance with the FHWA report. The weighting factors are fractional portions of unity. When all nine indicators established in FHWA report are used, the sum of weights is equal to one. In the case of Ravalli County, two indicators were omitted, the Traffic Conflict Indicator and the Erratic Maneuvers Indicator. Their exclusion from the study was not felt to be any deterrent in the ranking of hazardous sites. The use of seven indicators provides an 88.6% confidence in strength of evaluation.

Based on the hazard analysis for each site, a matrix of indicator values and final hazard index ratings was constructed on the Lotus system and a hazard index ranking was completed. Table 10. lists this ranking by site number, location, indicator values and hazard index. Also shown is statistical information for the indicator values and hazard index.

During the process of field data collection and subsequent indicator computations, it was discovered that values for the two subjective indicators could vary widely between consecutive observations and among non-experienced observers. If Ravalli County continues this program, they should retain traffic personnel who will continue to update the high hazard priority list on a long term basis and therefore, these indicators should remain as part of the hazard index ranking.

TABLE 10. SITE RANKING BY HAZARD INDEX VALUES SUMMARY OF INDICATOR VALUES

RANK NUMBER	INTERSECTION LOCATION	# OF ACC. IND VAL	# OF ACC. PART H.I.	ACC. RATE IND VAL	ACC. RATE PART H.I.	SEVERITY IND VAL	SEVERITY PART H.I.	V/C RATIO IND VAL	V/C RATIO PART H.I.	SIGHT DIST IND VAL	SIGHT DIST PART H.I.	EXPECT. IND VAL	EXPECT. PART H.I.	INFO DEF. IND VAL	INFO DEF. PART H.I.	TOTAL HAZARD INDEX
	* RELATIVES WEIGHTS :		0.163		0.224		0.190		0.082		0.074		0.148		0.115	1.000
1	SLEEPING CHILD ROAD - BEAR CR	54	8.80	100	22.40	100	19.00	11	0.90	100	7.40	75	11.10	100	11.50	81.10
2	SLEEPING CHILD ROAD - CURVES	72	11.74	100	22.40	54	10.26	11	0.90	88	6.51	67	9.92	83	9.55	71.27
3	OLD DARBY ROAD - COMO ROAD	72	11.74	89	19.94	51	9.69	21	1.72	100	7.40	72	10.66	83	9.55	70.69
4	AMBROSE ROAD	64	10.43	35	7.84	62	11.78	28	2.30	81	5.99	100	14.80	83	9.55	62.69
5	QUAST LANE RXR	33	5.38	83	18.59	54	10.26	21	1.72	58	4.29	83	12.28	83	9.55	62.07
6	PLEASANT VIEW ROAD	50	8.15	35	7.84	57	10.83	40	3.28	91	6.73	92	13.62	100	11.50	61.95
7	WILLOW CREEK ROAD RXR	40	6.52	46	10.30	59	11.21	43	3.53	71	5.25	92	13.62	75	8.63	59.06
8	MIDDLE BURNT FORK ROAD	54	8.80	55	12.32	41	7.79	18	1.48	87	6.44	75	11.10	58	6.67	54.60
9	OLD CORVALLIS ROAD - CURVES	54	8.80	21	4.70	54	10.26	50	4.10	58	4.29	67	9.92	58	6.67	48.74
10	OLD U.S. 93 - S OF MISS. CNTY	50	8.15	37	8.29	50	9.50	30	2.46	63	4.66	50	7.40	67	7.71	48.17
	AVERAGE VALUES :	54.3		60.1		58.2		27.3		79.7		77.3		79.0		62.0
	STANDARD DEVIATIONS :	11.9		28.4		14.9		12.8		15.4		14.1		14.1		9.8

EXPLANATION OF IMPROVEMENTS

The recommended improvements presented within this report are of two types. Short term improvements indicate the minimum amount of upgrading or modifications necessary to increase driver expectancy and to update the site to current standards. Long term improvements are normally considered viable when severe conditions at the site prevent short term improvements from completely satisfying the control measures necessary to prevent future problems. Since all of the long term improvements are dependant upon significant changes in the future operations and most of the sites were not of a nature that reliable predictions could be made, no costs or project ranking was completed. Many of the recommended improvements have sufficient latitude so that alternative measures could be suggested during design. The selection of recommended improvements was based on subjective engineering judgement.

At some of the sites, it was noted that a few traffic control devices were not in compliance with MUTCD. There also may be several locations where deficiencies may be critical and should be corrected as soon as possible.

The improvement sketches in all cases should not be considered design plans. The drawings are preliminary and are intended to present improvement concepts only in enough detail to provide the measure of control necessary and to provide cost estimates. In some cases, detailed survey data; design research; design plans and specifications; and construction layout will be necessary to effectively achieve the improvements.

BENEFIT/COST RATIOS

Costs - are developed by preliminary applying unit costs to required quantities based either on current prices as tabulated from average bid prices of similar projects or, where applicable, on prices established by Montana Department of Highways Project Planning Section. The costs should in no way be considered a quote or final estimate of actual work.

The following are traffic control devices and allowable costs that are eligible for funding by the Montana Department of Highways through their Off-System Safety Program:

A. Signs:

1.	1 square foot to 6 square feet	- $ 100.00
2.	6.1 square feet to 10 square feet	- $ 140.00
3.	10.1 square feet to 20 square feet	- $ 170.00
4.	supplementary sign on same post	- $ 50.00

B. Delineators:

1.	Design ""A" metal posts	- $ 9.25
2.	Design "A" flexible posts-6'	- $ 20.00
3.	Design "A" flexible posts-27"	- $ 6.00

C. Guardrail:

1.	New "W" Beam rail (per foot)	- $ 8.00
2.	"W" Beam end treatment (each)	- $1,000.00
3.	New concrete rail (per foot)	- $ 16.00
4.	New concrete end tapers (per foot)	- $ 16.00

Even though Ravalli County maintenance crews are capable of performing a good deal of work, costs related to physical changes in the roadway section are based on contract prices in order to correlate with costs requiring contract bid letting. The costs do not include administrative, engineering or field layout for the recommended improvements at the one site which would require final design plans. Engineering design will generally be required to produce contract plans and specifications. These costs should be evaluated prior to planning improvement projects requiring bids.

Benefits - are estimated by applying accident reduction forecasts based on the type of improvement recommended. The forecasts are based on the subjective evaluation by an experienced traffic engineer. This evaluation is aided by knowledge of accident experience at similar locations with the improvements existing. Also statistical studies relating certain improvements to accident reduction are used as a guide ie, Roy Jorgenson and Associates, "Evaluation of Criteria for Safety Improvements on the Highway" (Washington, D.C.: U.S. Bureau of Public Roads, Office of Highway Safety, 1966. p. 316).

The forecasted reduction is expressed as a percentage of each type of accident. This percentage is multiplied by the percentage of all accidents represented by each type. The total percent reduction of all accidents at each site is the sum of all accidents reduction percentages for each type.

The method used to compute benefits in this study follows the Montana Department of Highways procedures. Those procedures were programmed for the Lotus 123 Computer Software which provides a tabular summary of all variables in the computation.

If applied consistently, the economic benefit computation will provide a realistic estimate of average economic savings to society. The benefit amount should not be interpreted as a dollar value that Ravalli County will receive as a result of dollar outlay. It is a figure used to quantify the economic benefit to society that would occur if a certain number of accidents did not occur.

Ratio - of benefits to cost provides a numerical reference to the relative value of the recommended improvements. It is the desire of any improvement project to have a benefit-cost (B/C) ratio in excess of 1.0. If the B/C is less than 1.0 the project would have questionable justification. In this study, none of the sites had a B/C less than one. Table 11 is a computer generated summary of the B/C ranking for the study sites.

TABLE 11. SITE RANKING BY BENEFIT/COST RATIOS CALCULATION

RANK #	SITE LOCATION	PROJ LIFE	COSTS: CAPITOL COST IMPROVE	EQUIV ANNUAL COST	ANNUAL MAINT. COST CH.	TOTAL ANNUAL COST	BENEFITS: Q	Afi	Apd	PFI	Ppd	ANNUAL BENEFIT	B/C RATIO	IND VAL
1	SLEEPING CHILD ROAD - CURVES	5	$4,270	$1,126	$200	$1,326	$37,164	1.50	1.50	40%	40%	$24,126	18.19	97
2	AMBROSE ROAD	5	$8,290	$2,187	$100	$2,287	$37,164	1.75	0.50	34%	25%	$23,192	10.14	77
3	OLD DARBY ROAD - COMO ROAD	5	$6,950	$1,833	$100	$1,933	$37,164	1.25	1.75	28%	40%	$14,620	7.56	67
4	OLD CORVALLIS ROAD - CURVES	5	$6,480	$1,709	$50	$1,759	$37,164	0.75	0.75	43%	40%	$12,933	7.35	66
5	SLEEPING CHILD ROAD - BEAR CR	5	$1,680	$443	$100	$543	$37,164	0.25	1.25	30%	30%	$3,484	6.41	62
6	PLEASANT VIEW ROAD	5	$8,120	$2,142	$150	$2,292	$37,164	0.75	0.50	40%	40%	$11,907	5.19	55
7	OLD U.S. 93 - S OF MISS. CNTY	5	$3,570	$942	$50	$992	$37,164	0.25	1.00	40%	20%	$4,177	4.21	48
8	WILLOW CREEK ROAD RXR	5	$12,046	$3,178	$50	$3,228	$37,164	0.75	0.00	33%	0%	$9,566	2.96	36
9	QUAST LANE RXR	5	$3,996	$1,054	$50	$1,104	$37,164	0.25	0.25	30%	30%	$3,016	2.73	33
10	MIDDLE BURNT FORK ROAD	5	$11,040	$2,912	$50	$2,962	$37,164	0.25	1.25	40%	40%	$4,645	1.57	15
	TOTALS :		$66,442	$17,527	$900	$18,427						$111,665		
	AVERAGES :	5	$6,644	$1,753	$90	$1,843						$11,167	6.63	56

COMPOUNDED INTEREST RATE :	10%	
COST OF FATAL ACCIDENT :	$500,000	(1986 NATIONAL SAFETY COUNCIL DATA)
COST OF INJURY ACCIDENT :	$11,000	
COST OF PROPERTY DAMAGE ACCIDENT ;	$1,500	
I/F RATIO SECONDARY :	17.69	
ADTa/ADTb :	1.04	**VALUES FROM MDOH SAFETY SECTION**

PRIORITY INDEX

The ranking of site improvement priorities cannot be directly dependent on the hazard ranking of the study sites. The value of the improvements must enter into the priority listing in the form of the benefit/cost ratio (B/C). The method of developing a composite Hazard Index - B/C listing must be dependent on the relative index scale used in the hazard index computation. Therefore, a correlation of scale between the B/C ratio and hazard indicator value was developed on the following assumptions:

1. The contributing conditions creating hazards at each site and the resulting hazard ranking is relatively independent of the cost of correcting these conditions.

2. Benefits to be derived from correcting hazardous situations at each site is indirectly proportional to the degree of hazardness.

3. The benefit-cost ratio, by virtue of benefit computation, is indirectly proportional to the number of accidents indicator and severity indicator, both of which are curvilinear functions.

4. The benefit-cost ratios can be rated on a scale of 0 to 100 based on a curvilinear function.

5. The B/C ratio of 1.0 is equivalent to an indicator value of 0 and the upper limit (indicator value = 100) must be chosen to encompass the majority of sites. In this case a B/C of 20.0 assumes the indicator value of 100.

Based on these assumptions a graphic plot of the B/C ratio versus B/C indicator value has been established and it is shown in

Figure 10. Since it has been graphed on semi-log paper the line appears linear.

Since the relative weighting of benefit-costs and hazardness is a controversial subject which would require research beyond the scope of this report, it is felt that the priority index should be based on 33% weighting for the benefit-cost ratio and 67% weight on the hazard index. Therefore, to establish a priority index the following formula has been devised:

Priority Index = (Hazard Index) x (0.67)

+ (Cost-Benefit Indicator) x (0.33)

Table 12. is the computer generated summary of priority ranking based on the composite hazard index - benefit/cost index values.

TABLE 12. SITE RANKING BY PRIORITY INDEX - CALCULATION SUMMARY

PRIORITY NUMBER	INTERSECTION LOCATION	HAZARD INDEX	WEIGHTED VALUE	BEN/COST INDEX	WEIGHTED VALUE	PRIORITY INDEX
1	SLEEPING CHILD ROAD - CURVES	71.27	47.75	97	32.01	79.76
2	SLEEPING CHILD ROAD - BEAR CR	81.10	54.34	62	20.46	74.80
3	OLD DARBY ROAD - COMO ROAD	70.69	47.36	67	22.11	69.47
4	AMBROSE ROAD	62.69	42.00	77	25.41	67.41
5	PLEASANT VIEW ROAD	61.95	41.51	55	18.15	59.66
6	OLD CORVALLIS ROAD - CURVES	48.74	32.66	66	21.78	54.44
7	QUAST LANE RXR	62.07	41.59	33	10.89	52.48
8	WILLOW CREEK ROAD RXR	59.06	39.57	36	11.88	51.45
9	OLD U.S. 93 - S OF MISS. CNTY	48.17	32.27	48	15.84	48.11
10	MIDDLE BURNT FORK ROAD	54.60	36.58	15	4.95	41.53
	AVERAGE VALUES :	62.03	41.56	55.60	18.35	59.91
	STANDARD DEVIATIONS :	9.78	6.56	22.48	7.42	11.82

PRIORITY INDEX = (HAZARD IND. x .67) + (BEN/COST IND. x .33)

IMPLEMENTATION

Within Table 13, the priority lists have been arranged in a manner in which budget considerations can readily be applied in the decision to proceed with improvements. The priority ranking was the major consideration in selecting which sites will be receiving funds first. Since limited funds are available, it is necessary to skip over a few higher priority projects to improve a greater number of sites as soon as possible. The listing assumes that eligible project costs will be funded by MDOH Off-system Safety funds. The MDOH project funding limit is less than $ 10,000 per project period, or else formal bid letting procedures would be required by MDOH. This dollar figure is used as the criteria to define construction groupings. The estimated costs not covered by MDOH funds are considered County funding requirements. If Ravalli County forces perform this work, the actual costs would probably be much less.

There is no timetable given for these improvements. It may be conceivable that MDOH could fund more than one of the site groups in a single year, depending on available funding. The County will want to request funding from MDOH by submitting this report to Steve Kologi, P.E., Administrator, Program Development Coordinator.

TABLE 13. PROJECT IMPLEMENTATION GROUPINGS

PRIORITY NUMBER	LOCATION	COST ESTIMATE	M. D. O. H. ELIGIBLE FUNDS	COUNTY FUNDS
1	SLEEPING CHILD ROAD @ 7 MILES	$4,270.00	$3,570.00	$700.00
2	SLEEPING CHILD ROAD -BEAR CREEK	$1,680.00	$1,320.00	$360.00
3	OLD DARBY ROAD - COMO ROAD	$6,950.00	$2,790.00	$4,160.00
6	OLD CORVALLIS ROAD	$6,480.00	$1,640.00	$4,840.00
7	QUAST LANE RXR	$3,996.00	$0.00	$3,996.00
8	WILLOW CREEK RD RXR	$12,046.00	$150.00	$11,896.00
	CONSTRUCTION GROUP #1 TOTALS =	$35,422.00	$9,470.00	$25,952.00
4	AMBROSE ROAD	$8,290.00	$2,750.00	$5,540.00
5	PLEASANT VIEW ROAD	$8,120.00	$2,920.00	$5,200.00
9	OLD U.S. 93	$3,570.00	$1,270.00	$2,300.00
10	MIDDLE BURNT FORK ROAD	$11,040.00	$2,980.00	$8,060.00
	CONSTRUCTION GROUP #2 TOTALS =	$31,020.00	$9,920.00	$21,100.00
	TOTAL ALL CONSTRUCTION =	$66,442.00	$19,390.00	$47,052.00

PROGRAM CONTINUATION

Since the basic format of the study has been outlined and an initial priority list established, continuance of the program is strongly advised. The findings and recommendations of this study will soon become obsolete without continued updating at least on an annual basis.

The following recommendations in the continuance of the program are offered to Ravalli County:

1. The Department of Justice should continue to be assessed for copies of accident reports.

2. One person should be assessed with the responsibility of the program to insure that all data is being supplied, processed and filed.

3. An accident cluster map should be maintained.

4. Criteria should be developed for the inclusion of additional sites to be analyzed.

5. Coordinate any traffic counting programs that may exist or establish a counting program.

6. Analyze new sites according to the procedures of this study and include them in the priority list when warranted.

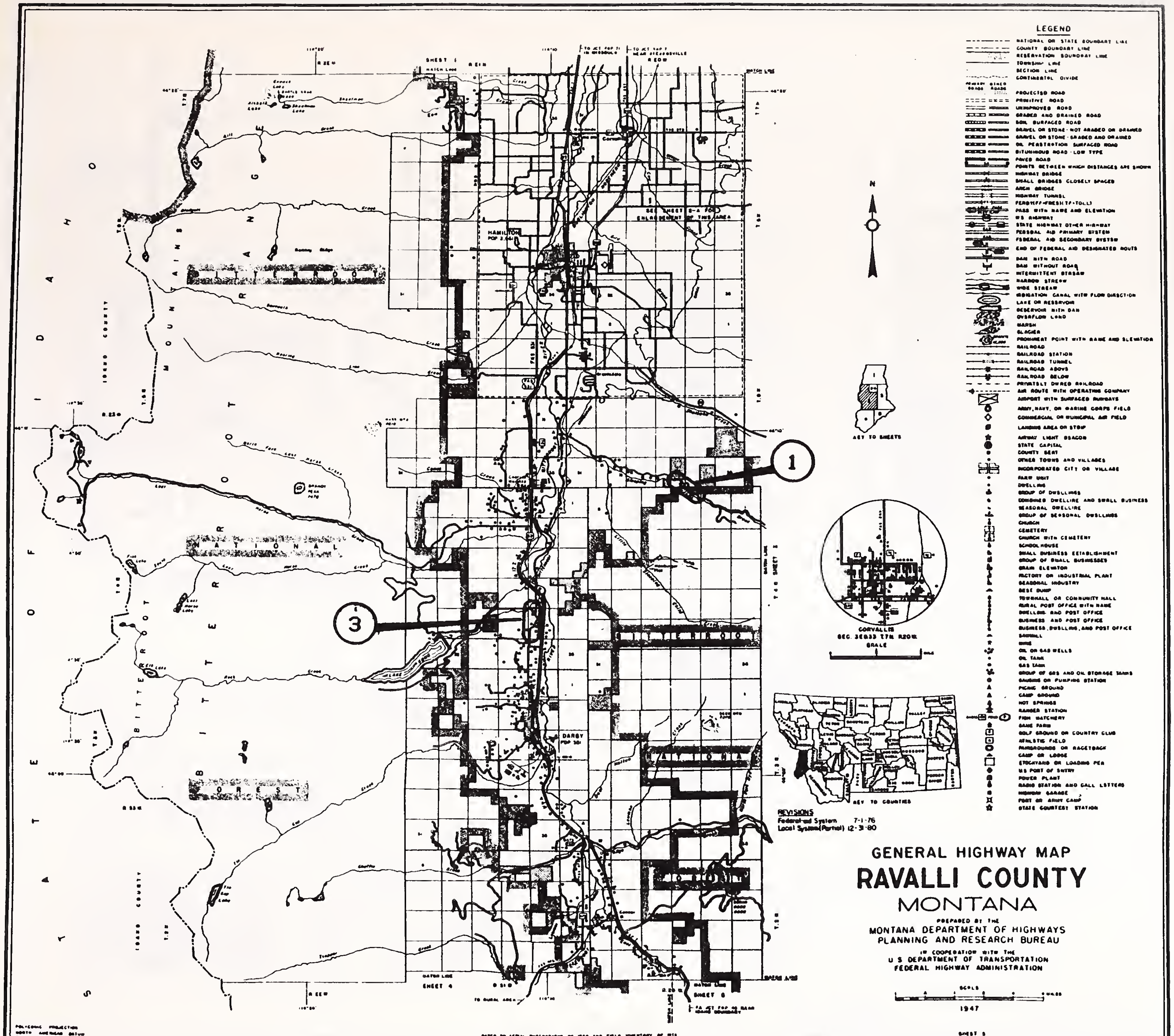
All of the data processing and storage can be handled by the Lotus 123 software. If an IBM compatible computer is available for use by the county, a copy of the data disk has been provided.

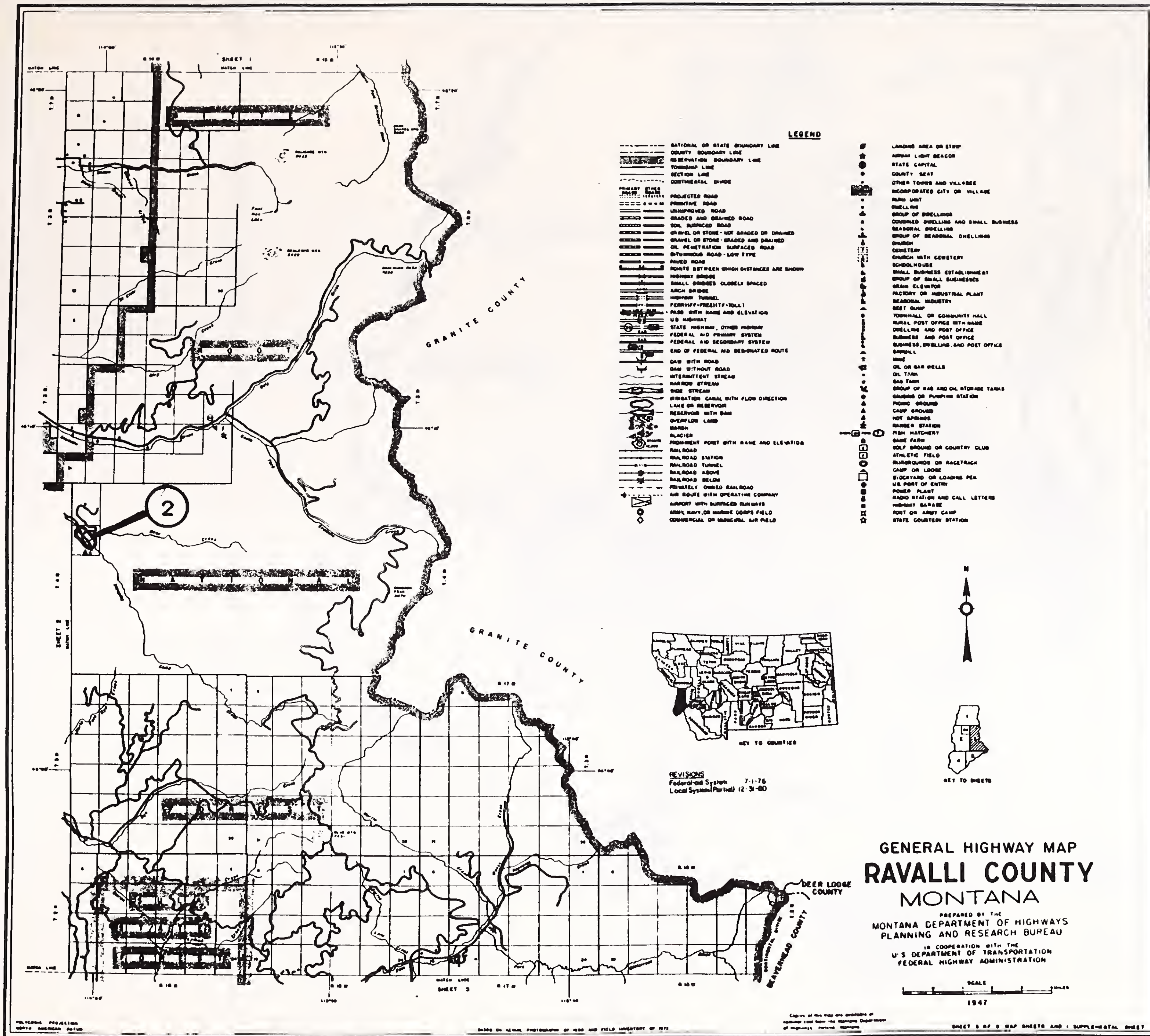
REPORT

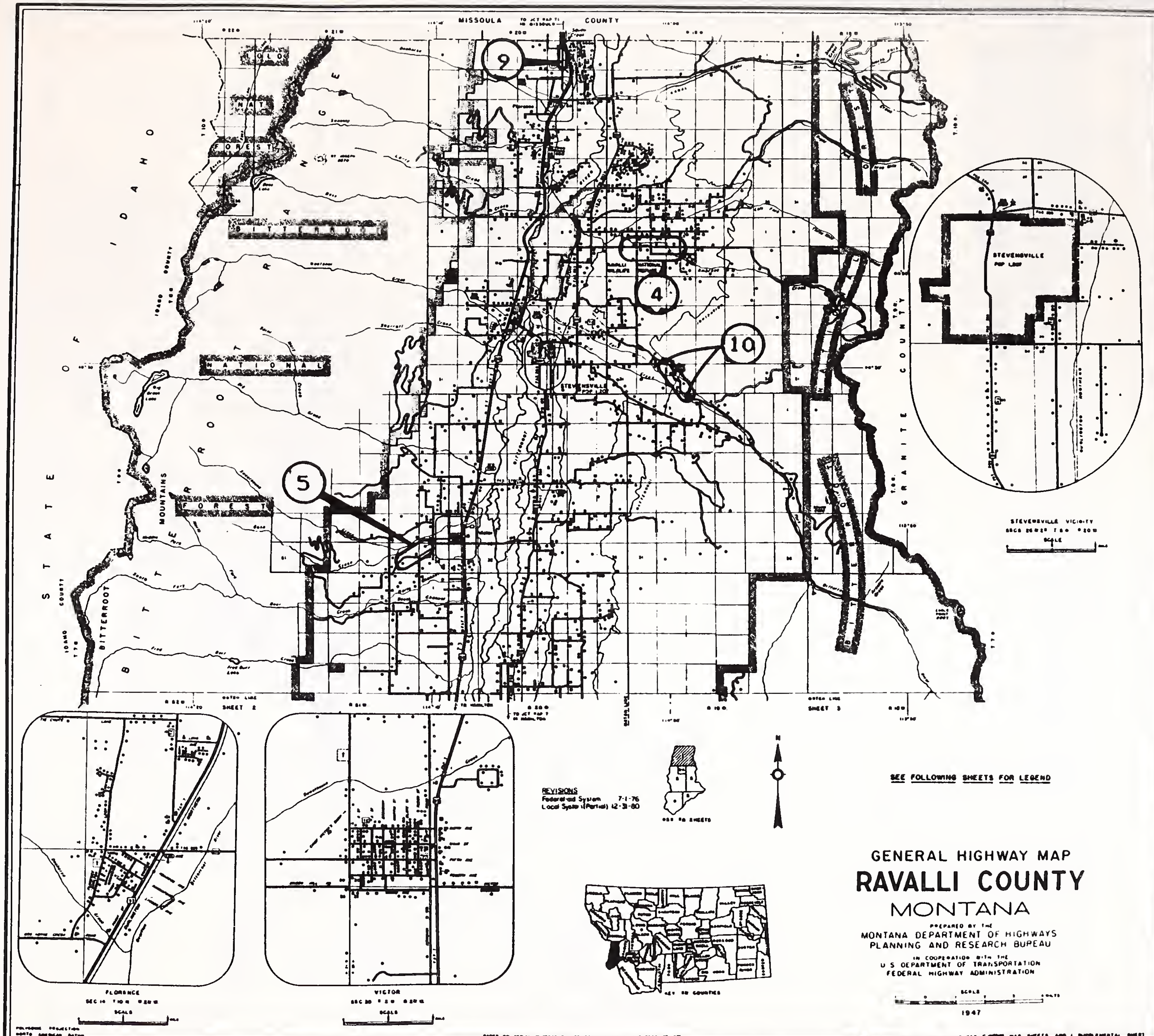
FIGURES

FIGURE 1.

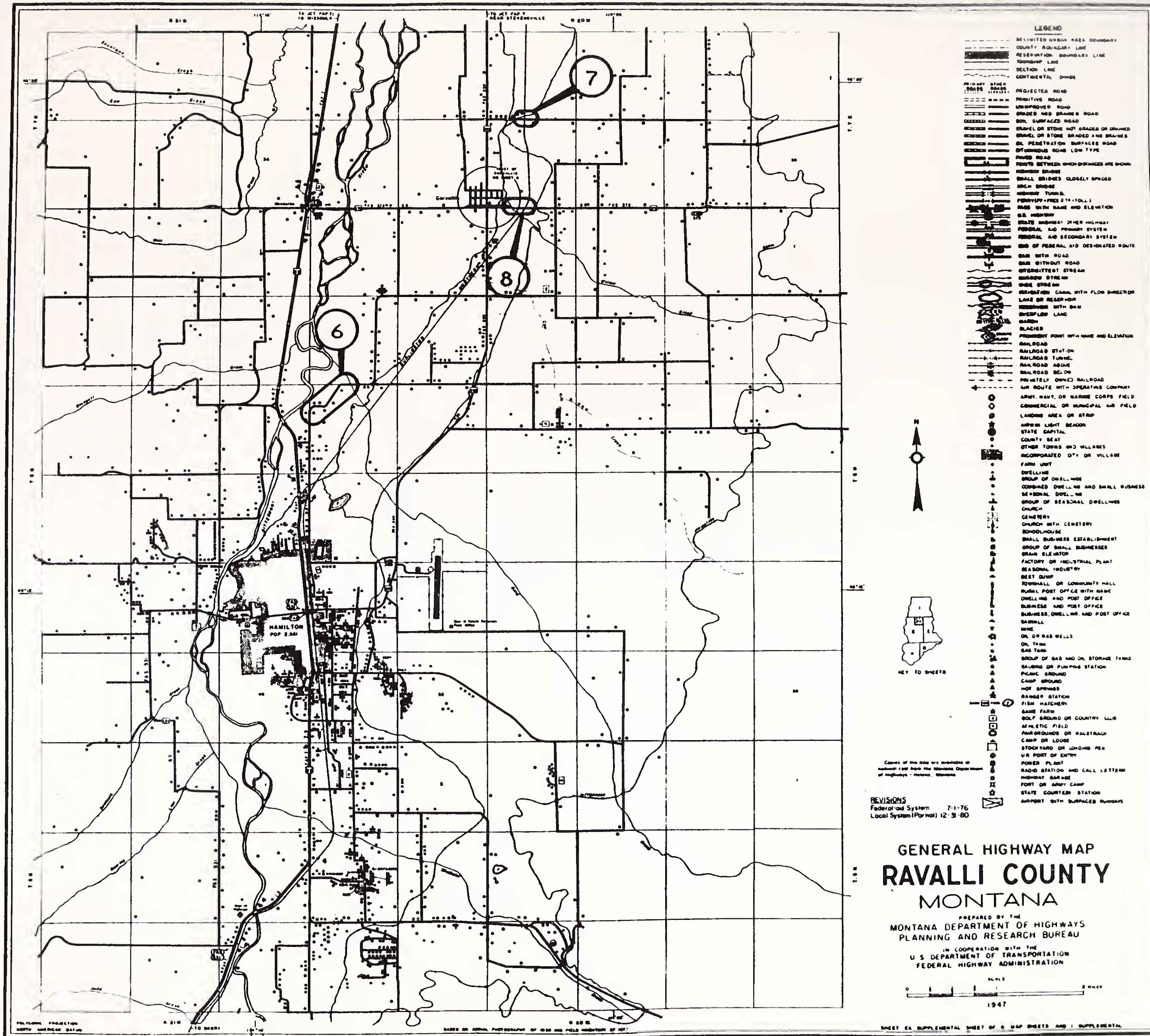
SITE LOCATION MAPS


GENERAL HIGHWAY MAP
RAVALLI COUNTY
MONTANA
PREPARED BY THE
MONTANA DEPARTMENT OF HIGHWAYS
PLANNING AND RESEARCH BUREAU
IN COOPERATION WITH THE
U S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
1947
LEGEND
REVISIONS
Federal-aid System 7-1-76
Local System(Partial) 12-31-80
KEY TO SHEETS
KEY TO COUNTIES
CORVALLIS
HAMILTON
DARBY
IDAHO
STATE OF
BITTERROOT
NATIONAL
FOREST
MOUNTAINS
RANGE
1
3


LEGEND
GRANITE COUNTY
GRANITE COUNTY
DEER LODGE COUNTY
BEAVERHEAD COUNTY
SHEET 1
SHEET 2
SHEET 3
N
KEY TO COUNTIES
KEY TO SHEETS
REVISIONS
Federal-aid System 7-1-76
Local System (Partial) 12-31-80
GENERAL HIGHWAY MAP
RAVALLI COUNTY
MONTANA
PREPARED BY THE
MONTANA DEPARTMENT OF HIGHWAYS
PLANNING AND RESEARCH BUREAU
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
SCALE
1947
2



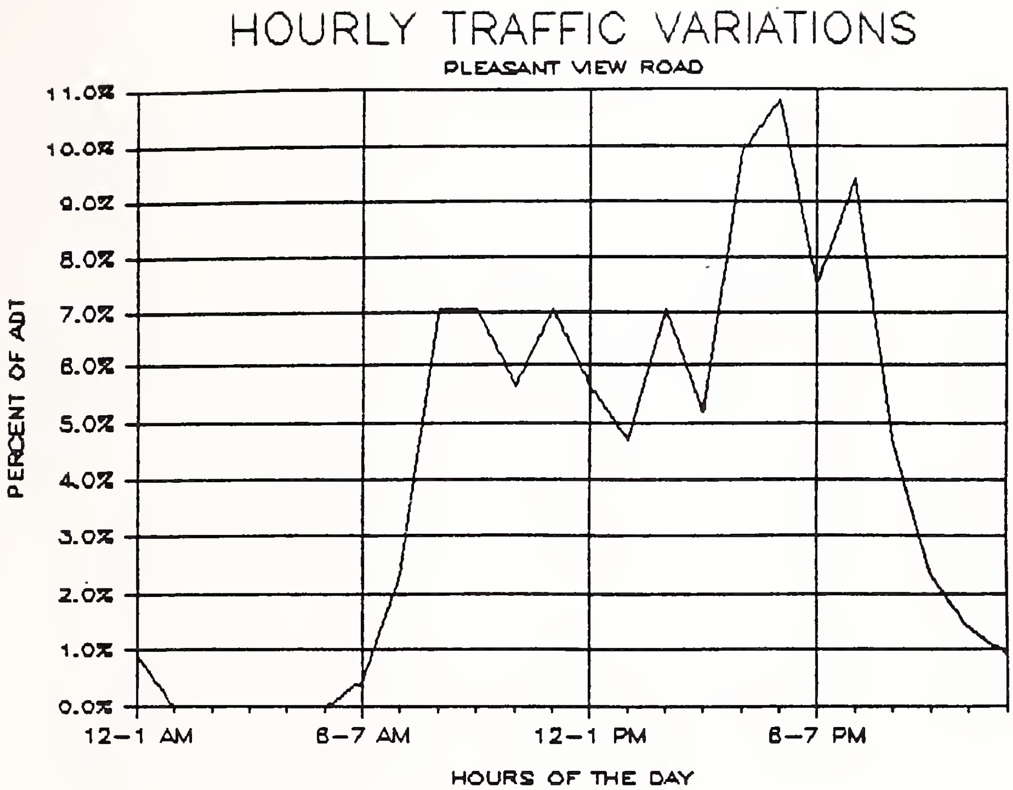
MISSOULA COUNTY
STATE OF IDAHO
BITTERROOT NATIONAL FOREST
LOLO NAT FOREST
BITTERROOT MOUNTAINS
GRANITE COUNTY
STEVENSVILLE
9
4
10
5
SHEET 2
SHEET 3
FLORENCE
VICTOR
STEVENSVILLE VICINITY
STEVENSVILLE POP 1207
SCALE
REVISIONS
Federal-aid System 7-1-76
Local System (Partial) 12-31-80
KEY TO SHEETS
KEY TO COUNTIES
N
SEE FOLLOWING SHEETS FOR LEGEND
GENERAL HIGHWAY MAP
RAVALLI COUNTY
MONTANA
PREPARED BY THE
MONTANA DEPARTMENT OF HIGHWAYS
PLANNING AND RESEARCH BUREAU
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
1947



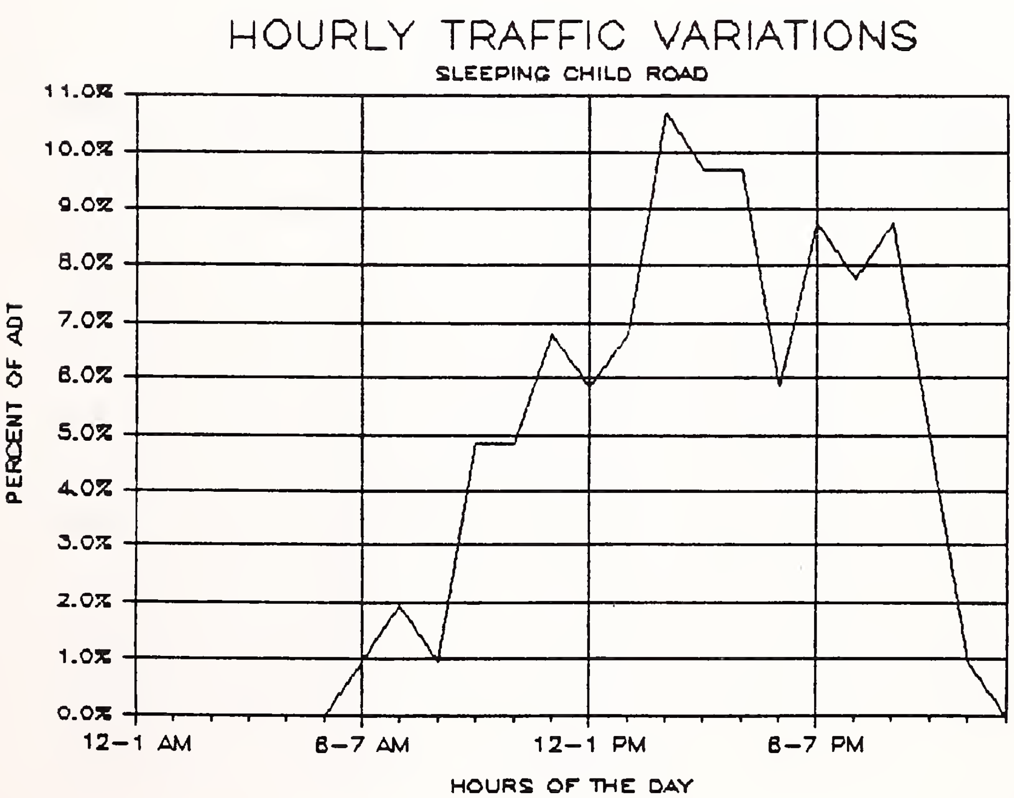
LEGEND
7
8
6
HAMILTON
POP 2,661
N
KEY TO SHEETS
REVISIONS
Federal-aid System 7-1-76
Local System (Partial) 12-31-80
GENERAL HIGHWAY MAP
RAVALLI COUNTY
MONTANA
PREPARED BY THE
MONTANA DEPARTMENT OF HIGHWAYS
PLANNING AND RESEARCH BUREAU
IN COOPERATION WITH THE
U S DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
1947
GENERAL HIGHWAY MAP RAVALLI COUNTY MONTANA

FIGURE 2.

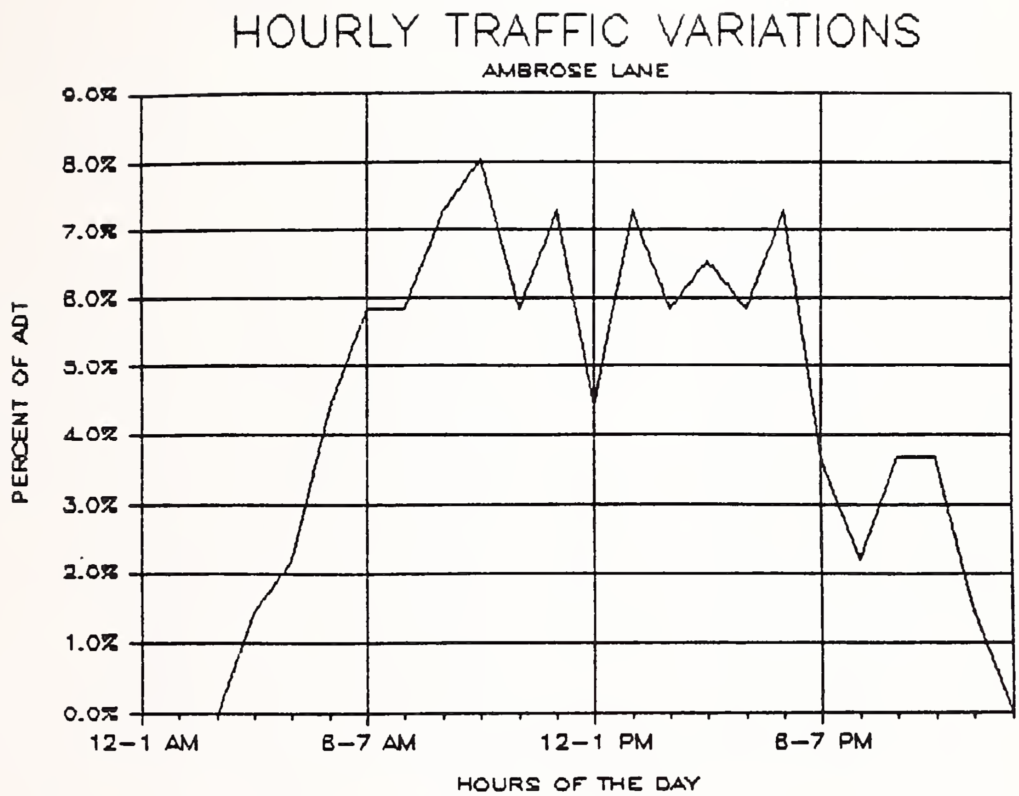
HOURLY TRAFFIC VARIATIONS

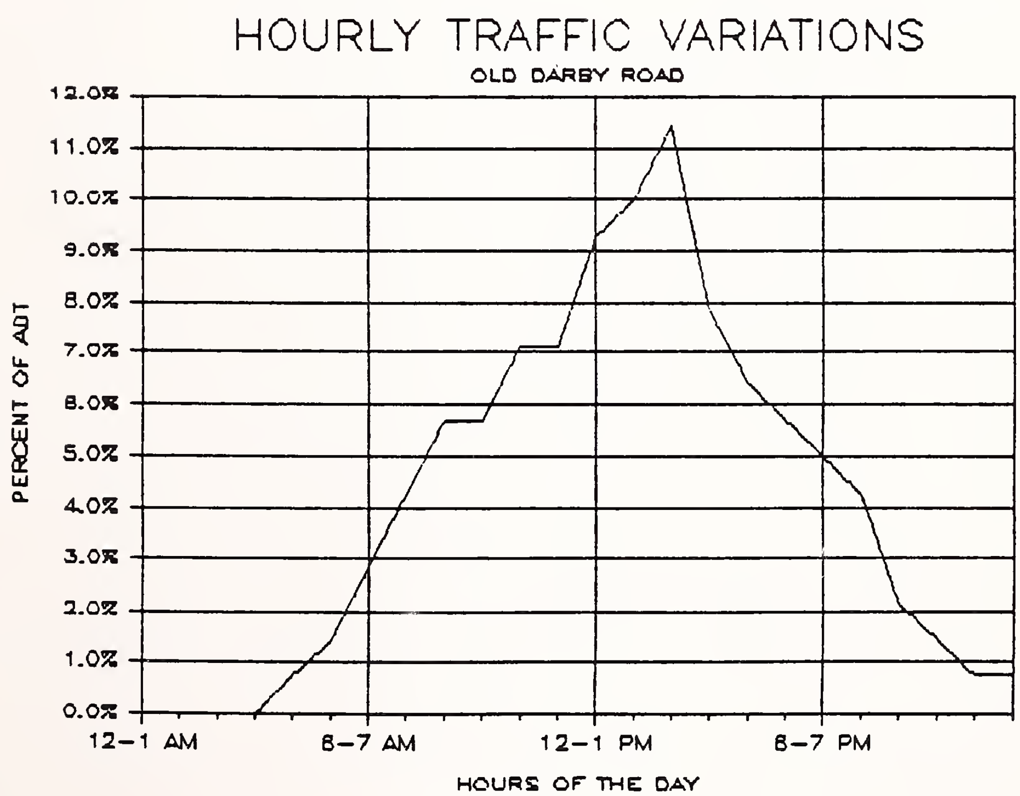


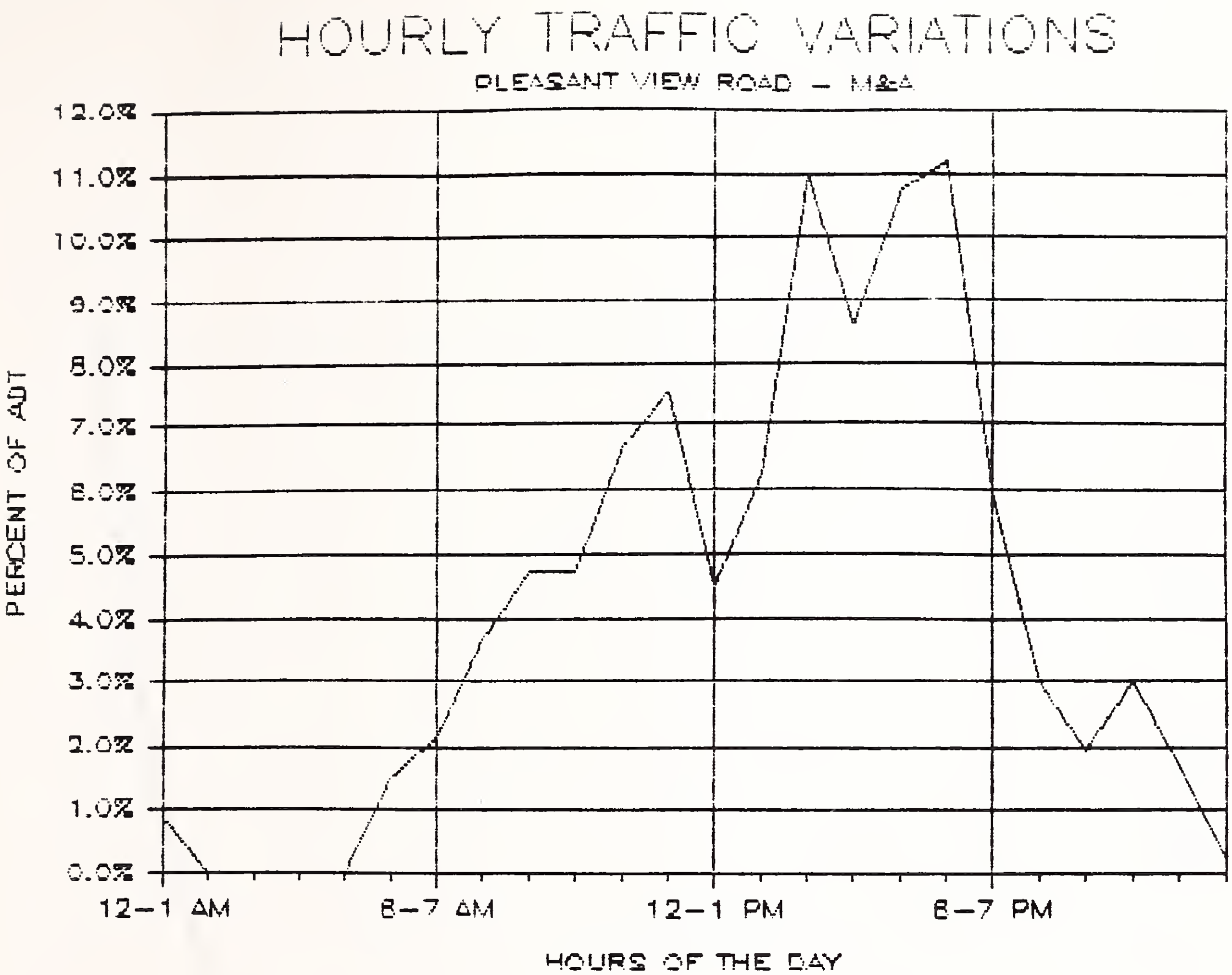
HOURLY TRAFFIC VARIATIONS
PLEASANT VIEW ROAD
11.0%
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
PERCENT OF ADT
12-1 AM
6-7 AM
12-1 PM
6-7 PM
HOURS OF THE DAY



HOURLY TRAFFIC VARIATIONS
SLEEPING CHILD ROAD
11.0%
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
PERCENT OF ADT
12-1 AM
6-7 AM
12-1 PM
6-7 PM
HOURS OF THE DAY


HOURLY TRAFFIC VARIATIONS
AMBROSE LANE
PERCENT OF ADT
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
12-1 AM
6-7 AM
12-1 PM
6-7 PM
HOURS OF THE DAY


HOURLY TRAFFIC VARIATIONS
OLD DARBY ROAD
PERCENT OF ADT
12.0%
11.0%
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
12-1 AM
6-7 AM
12-1 PM
6-7 PM
HOURS OF THE DAY



HOURLY TRAFFIC VARIATIONS
PLEASANT VIEW ROAD — M&A
PERCENT OF ADT
12.0%
11.0%
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
12—1 AM
6—7 AM
12—1 PM
6—7 PM
HOURS OF THE DAY

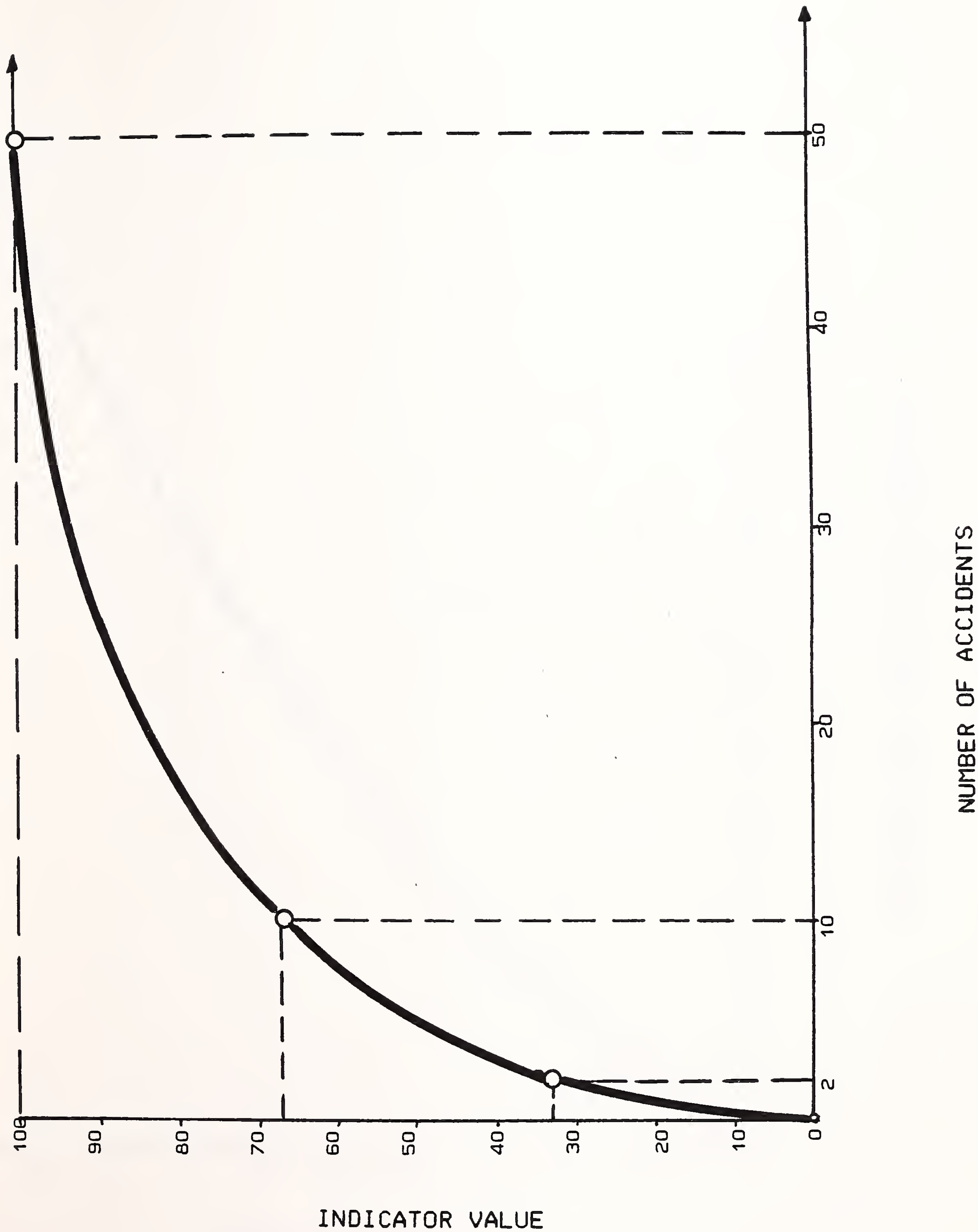


FIGURE 3. NUMBER OF ACCIDENTS INDICATOR

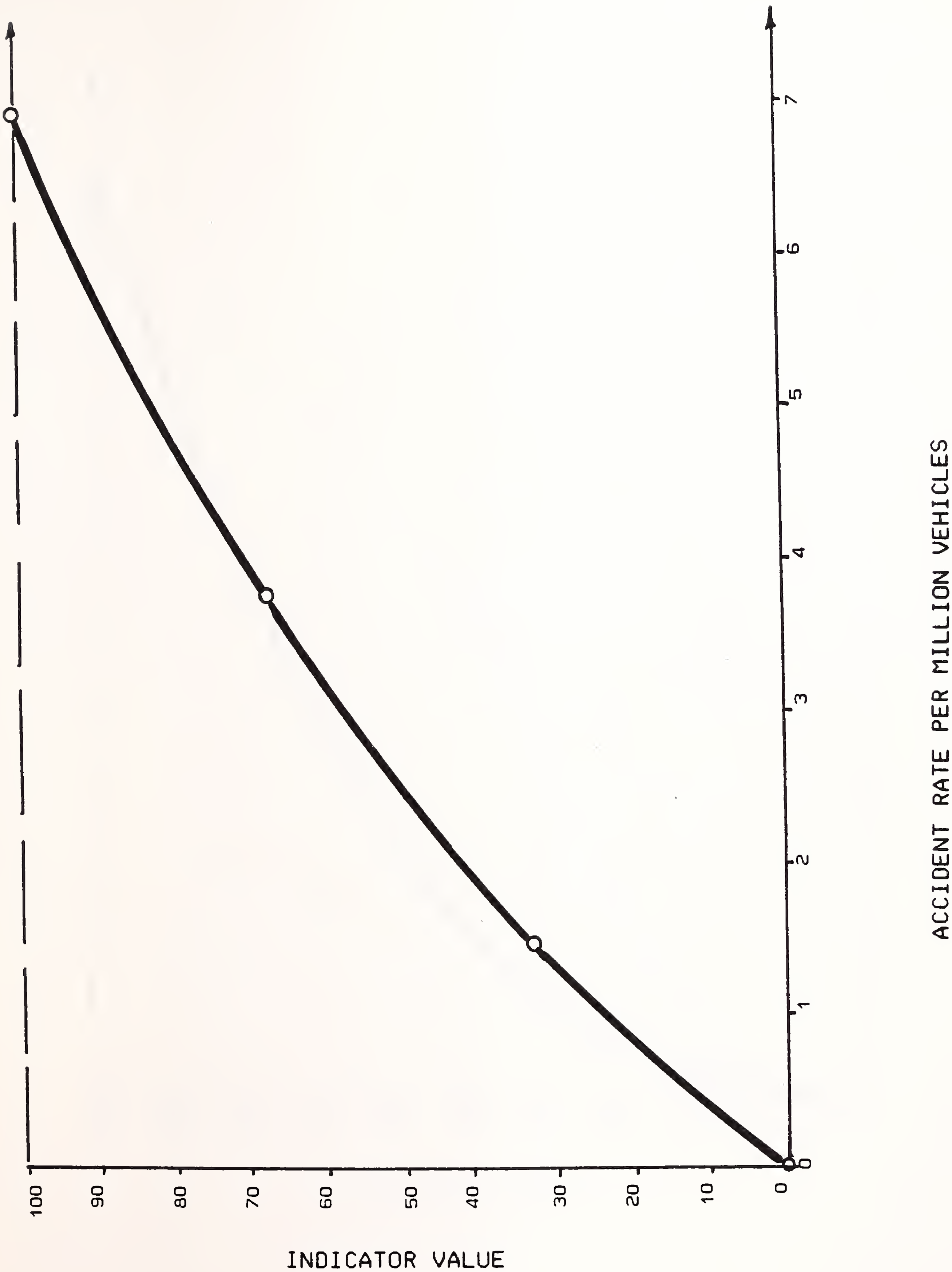


FIGURE 4. ACCIDENT RATE INDICATOR

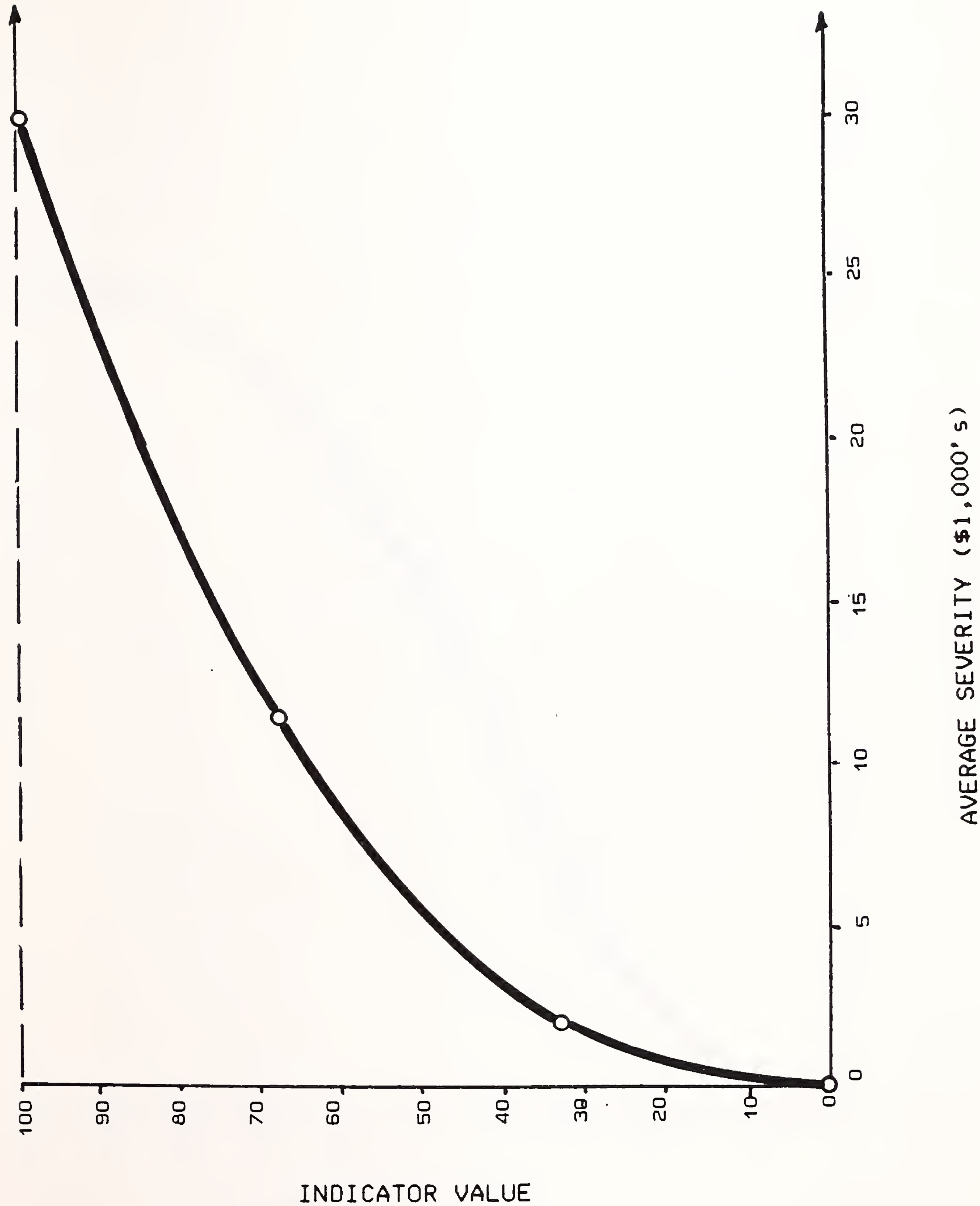


FIGURE 5. ACCIDENT SEVERITY INDICATOR

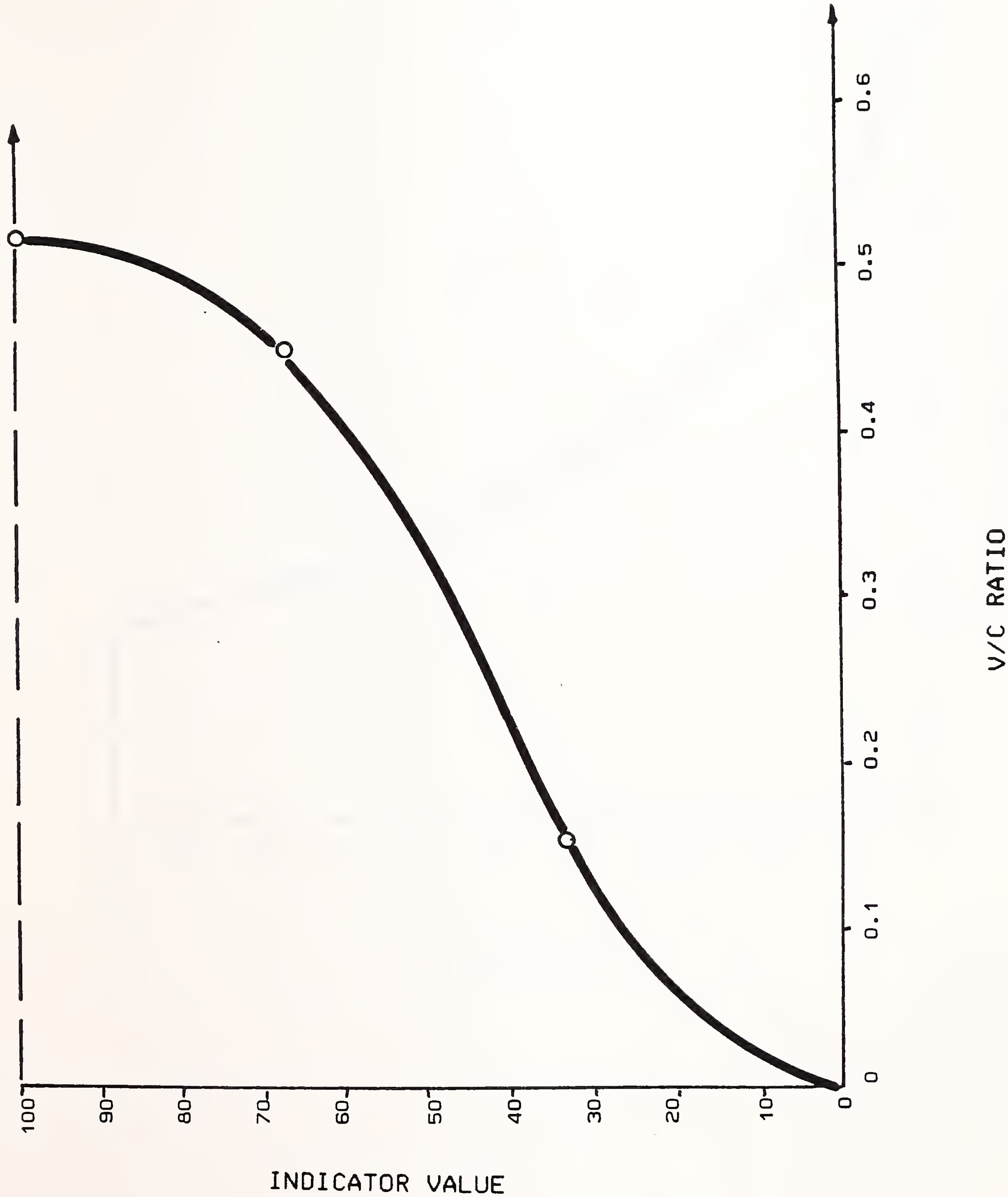


FIGURE 6. V/C RATIO INDICATOR

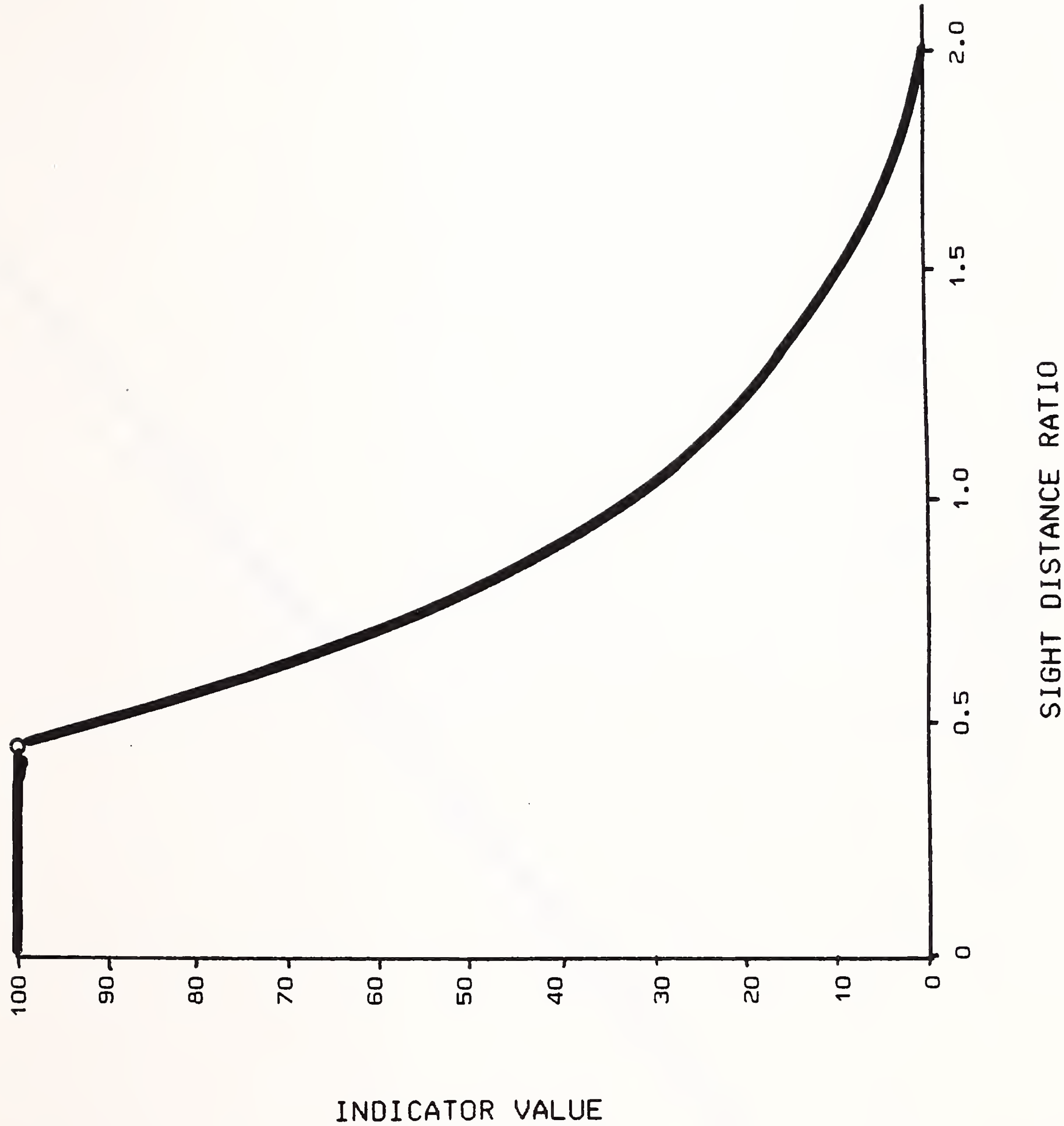


FIGURE 7. SIGHT DISTANCE INDICATOR

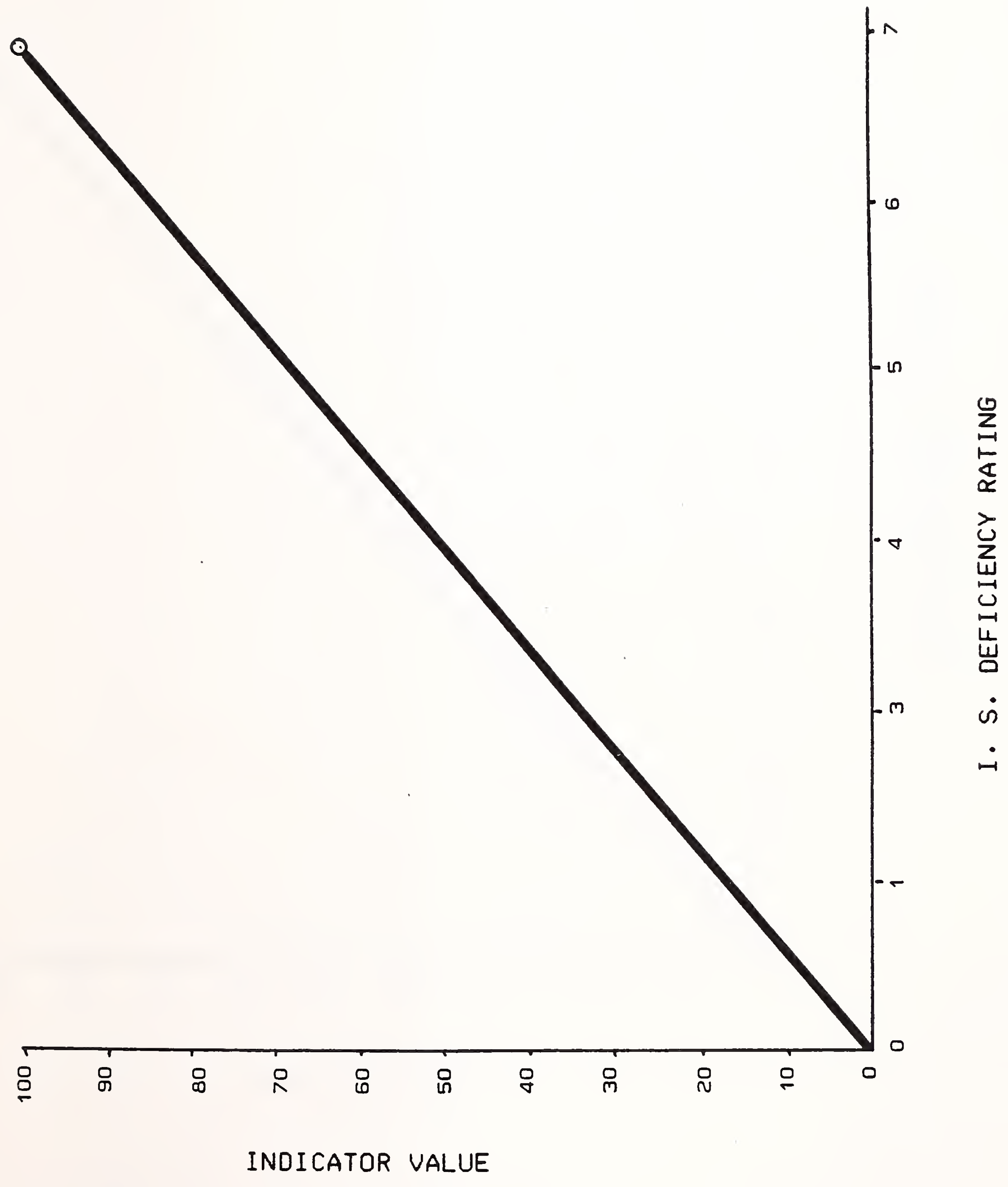


FIGURE 8. INFORMATION DEFICIENCY INDICATOR

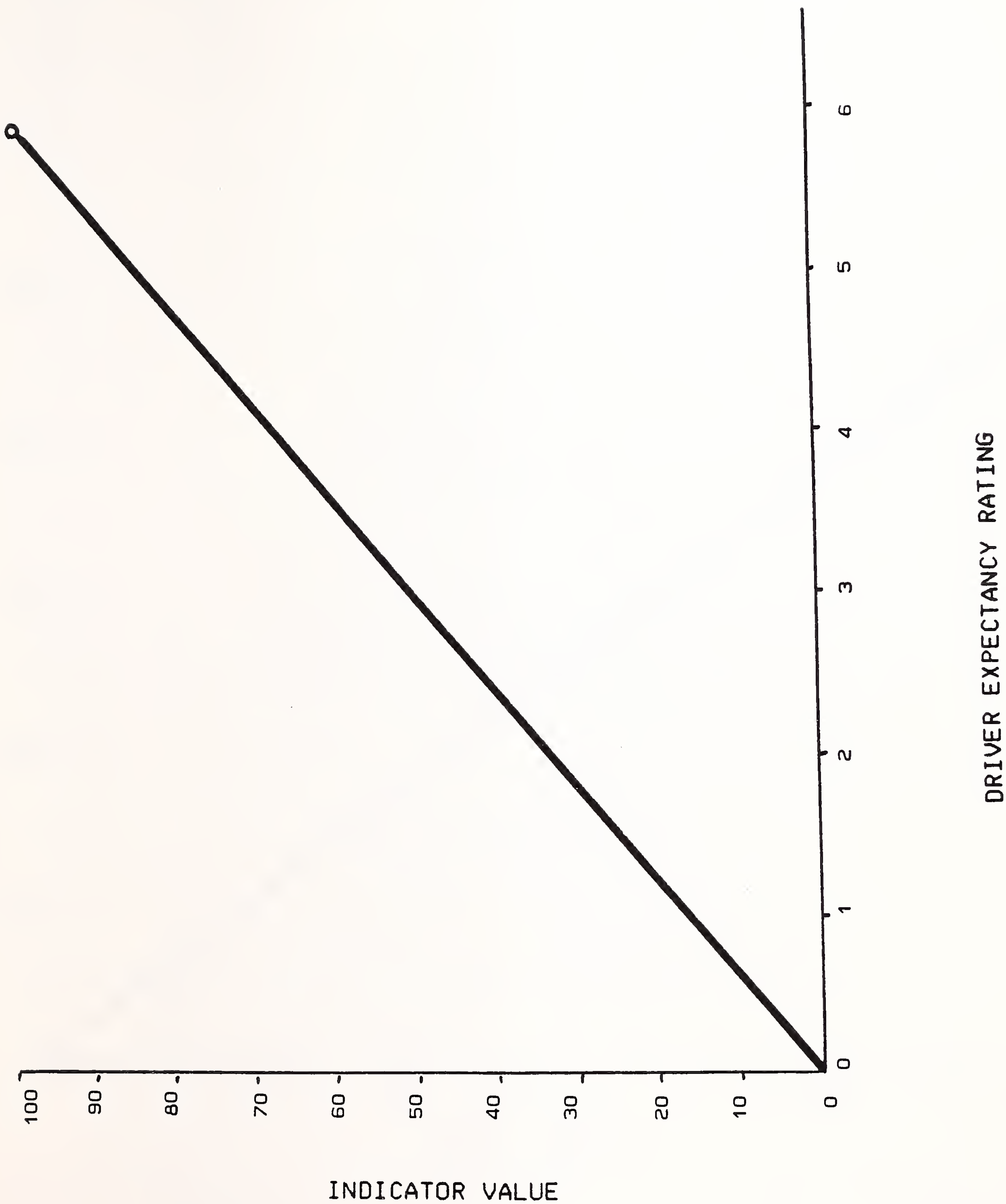


FIGURE 9. DRIVER EXPECTANCY INDICATOR

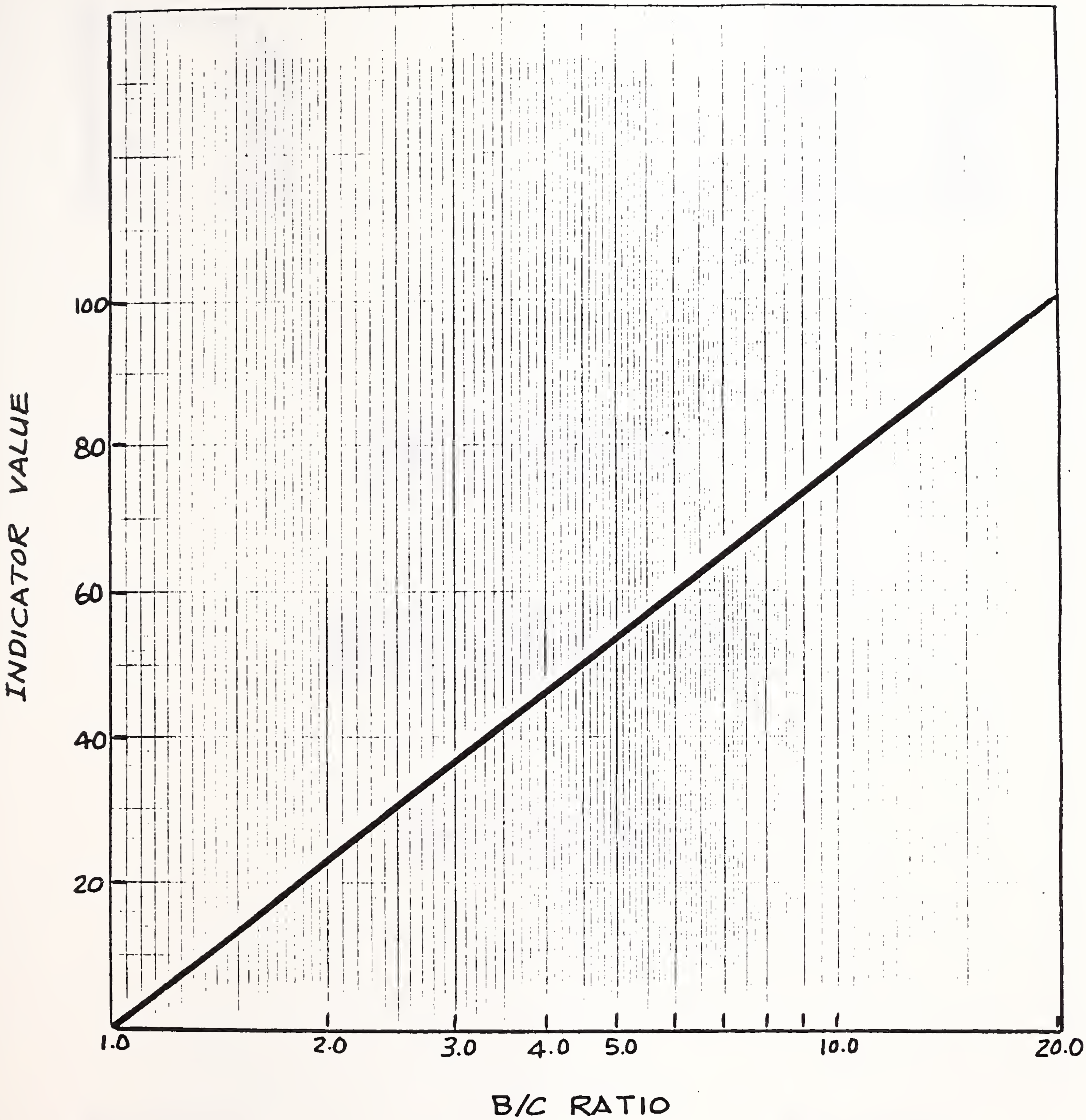


FIGURE 10. BENEFIT/COST RATIO

INDIVIDUAL

SITE ANALYSIS

SECTIONS

SITE #1

SLEEPING CHILD RD @ 7 MILES
PRIORITY NUMBER 1

SITE DESCRIPTION

Sleeping Child Road is a rural mountain road which provides access to camp sites, small farms and a resort type business at the southern end of the road. It begins at an intersection with Skalkaho Road, just south of Hamilton and west of Grantsdale. It proceeds in a southeast direction for approximately 11 miles, and ends at the Sleeping Child Hot Springs parking lot. The first 6.5 miles of this road are paved , while the remainder of the road is a gravel surface.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are spread out among the first series of curves starting at the end of the pavement and extending approximately 0.8 miles to the southeast. The paved section of road has an extended tangent prior to the first right hand curve. The pavement ends just prior to the start of the reverse curve to the left. The gravel road varies in width from 26 to 46 feet throughout this section. The grade is a fairly constant 2-3% raising to the southeast as it winds along the canyon floor adjacent to the creek. Trees line the roadway and often infringe upon the shoulders.

Traffic Control Devices. The only traffic control devices in this section are a "Pavement Ends" sign and a "Winding Curve - Next 5 Miles" sign for the southbound direction. Both signs are located on the paved section of roadway. The "Pavement Ends" sign is obscured by vegetation and is in poor condition. The "Winding Curves" sign is inherently vague, but its location does nothing to warn of the immediate dangers pending.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 110 vehicles per day. Traffic volumes throughout the past four years have probably remained relatively constant. County counts in 1988 indicated the same level. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious conflicts were observed on this section of roadway. Traffic volumes are so low that it is difficult to determine driver and vehicle reaction to the situations encountered. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors have combined to create potential problems at this site.

1. The roadway geometrics at the first curve site are extreme in comparison to the previous section of paved road.

2. The paved section north of the site gives a false impression of the road ahead. Even with the warning sign you

would not expect the pavement to end in the middle of reverse curves and you cannot visually perceive the end of pavement.

3. Warning signs only advise of curves in general. The unfamiliar motorist must traverse the first curves to determine how to drive them. In this case the first curves are the worst.

4. The gravel sections have developed a washboard surface that causes loss of control even at low speeds (20-30 MPH).

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were twelve accidents recorded in the four year study period. There seems to be a downward trend in the annual number of accidents with 6 occurring in 1985 and only 1 in 1988. All of the accidents were single vehicle accidents and 5 of them were directly attributable to the washboard condition of the road surface.

The majority of accidents occurred on dry roads in fair weather conditions. A small majority of accidents occurred during nighttime conditions. Property damage accidents and injury accidents occurred with the same frequency. Alcohol use had no involvement with any of the accidents.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Proper curve warning signs indicating the degree of severity of the first curve in the series

is important and will do more to slow approaching traffic than the pavement ending sign. The winding curve sign should be moved past the first curve so that drivers do not have to try to perceive its meaning while trying to negotiate through a difficult area. Delineation along the remainder of the site curves will provide positive guidance especially during inclement weather or during nigh time conditions. Increased maintenance on the road surface will improve control of vehicle dynamics, especially for southeast bound traffic. Application of additional gravel on the curve sections should probably not be continued since it only reduces vehicle control in its loosened state. If anything, a gravel road mix surface coarse with more fines should be layed and compacted and/or double penetration asphalt applied.

The cost of these improvements is estimated to be approximately $4,270 based on 1989 unit bid contract prices and MDOH fund eligible prices.

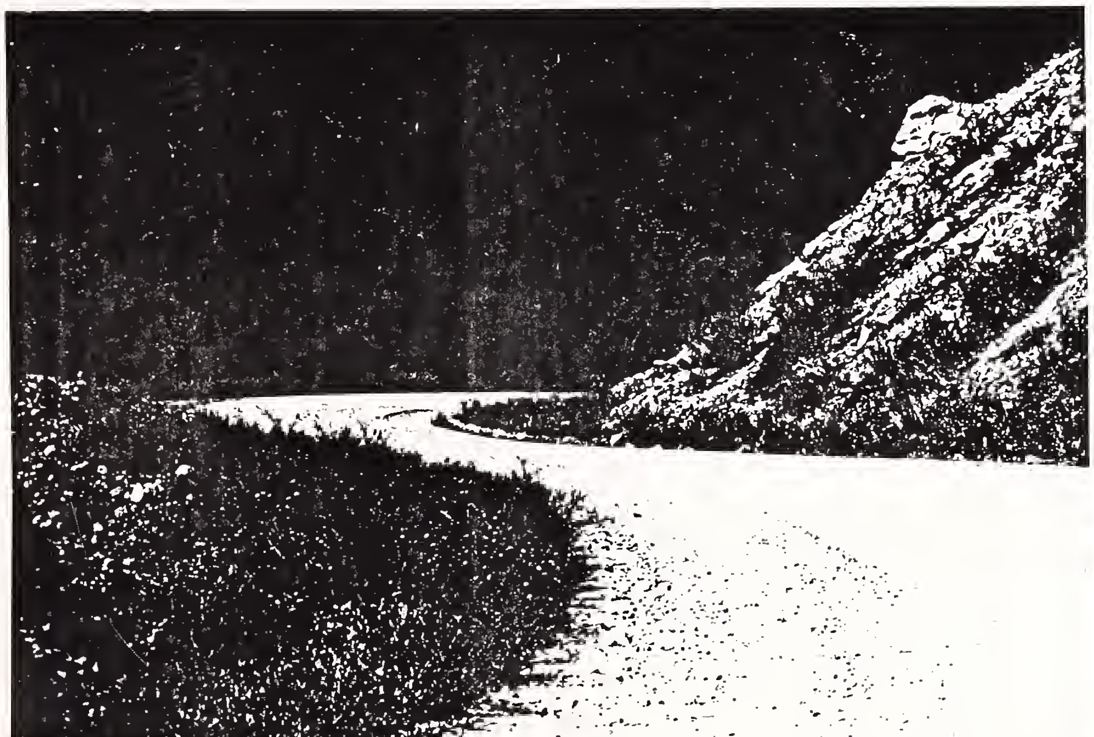
Long term improvements at this site are indicated on the short term improvement sketch. The widening and paving of the first curve after the existing pavement end would eliminate the number of situations encountered by motorists approaching this section and the end of pavement would be highly visible.

BENEFITS

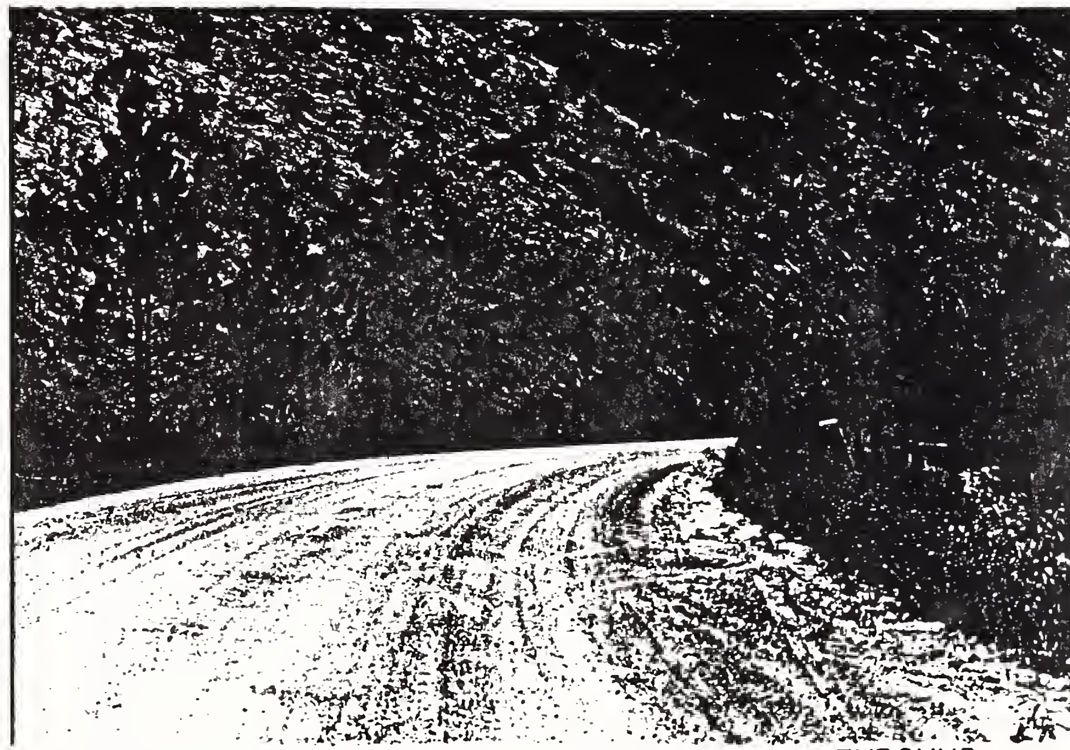
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $24,126 annually. The benefit/cost ratio is computed according to accepted methods at 18.19, highest of all the study sites.

SLEEPING CHILD RD. END OF PAVE, NORTHBOUND

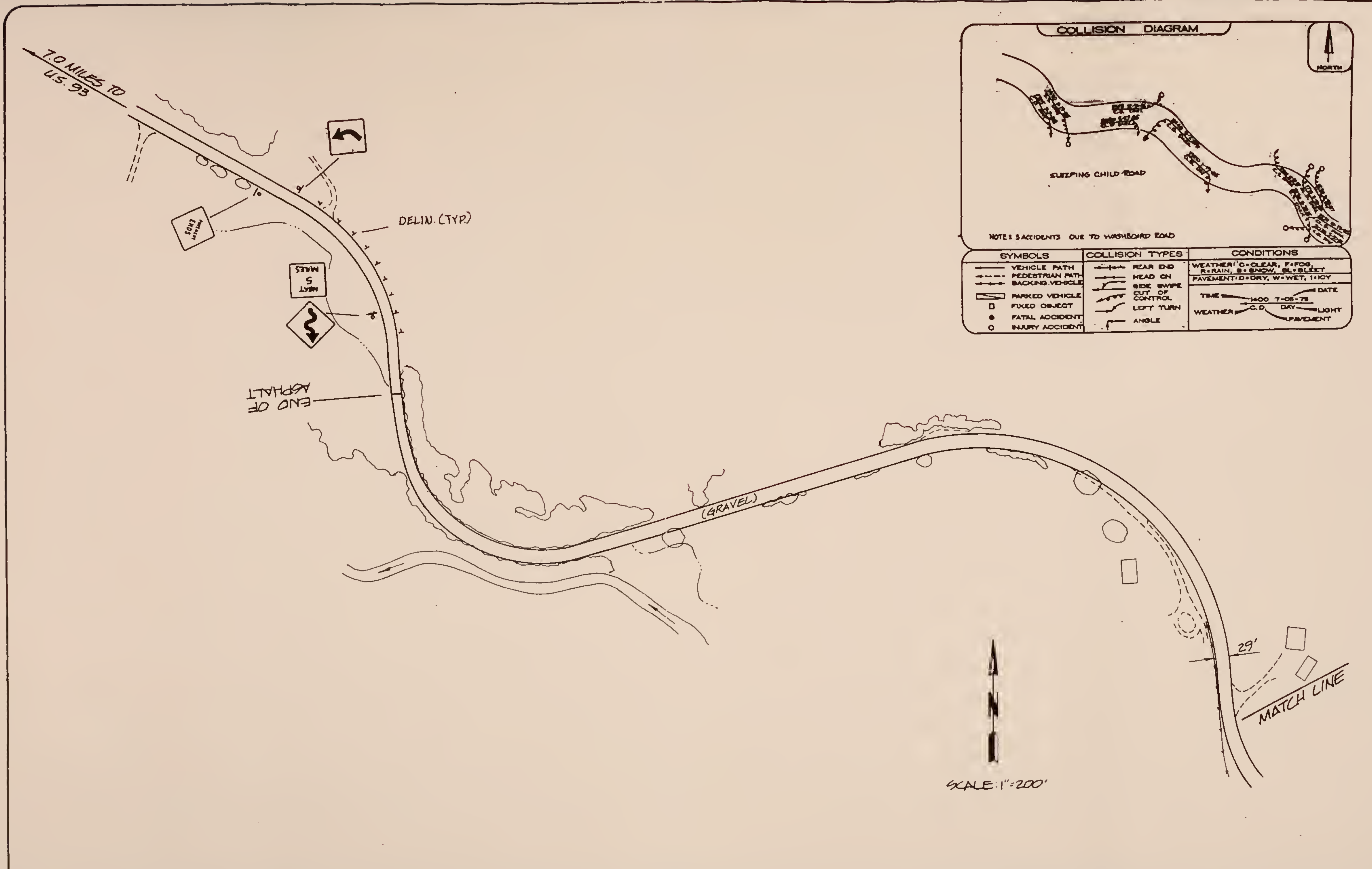
SLEEPING CHILD RD. END OF PAVE, SOUTHBOUND



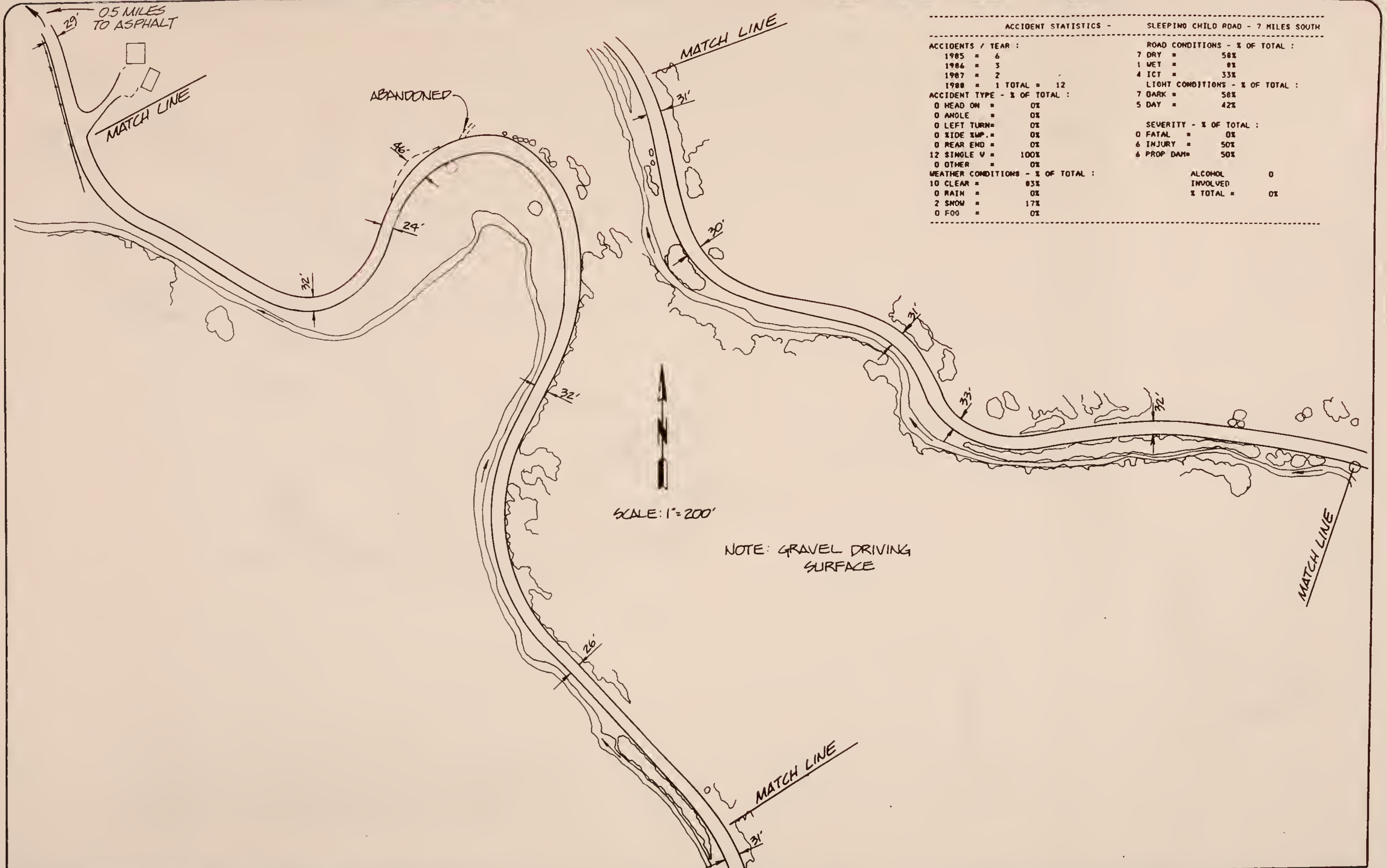
SLEEPING CHILD RD. .5 MILES S., NORTHBOUND



SLEEPING CHILD RD. .3 MILES S., SOUTHBOUND



MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph. (406) 248-5088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: SLEEPING CHILD ROAD @ END OF PAVEMENT EXISTING CONDITIONS	Surveyed By: Designed By: Drawn By Checked By: Date:	Revisions No. Date No. Date No. Date No. Date	Project No. Client No.	Sheet No. 1 of



ACCIDENT STATISTICS - SLEEPINO CHILD ROAD - 7 MILES SOUTH

ACCIDENTS / TEAR :
1985 = 6
1986 = 3
1987 = 2
1988 = 1 TOTAL = 12

ACCIDENT TYPE - % OF TOTAL :
0 HEAD ON = 0%
0 ANOLE = 0%
0 LEFT TURN= 0%
0 %IDE %WP.= 0%
0 REAR END = 0%
12 SINOLE V = 100%
0 OTHER = 0%

WEATHER CONDITIONS - % OF TOTAL :
10 CLEAR = 83%
0 RAIN = 0%
2 SNOW = 17%
0 FOO = 0%

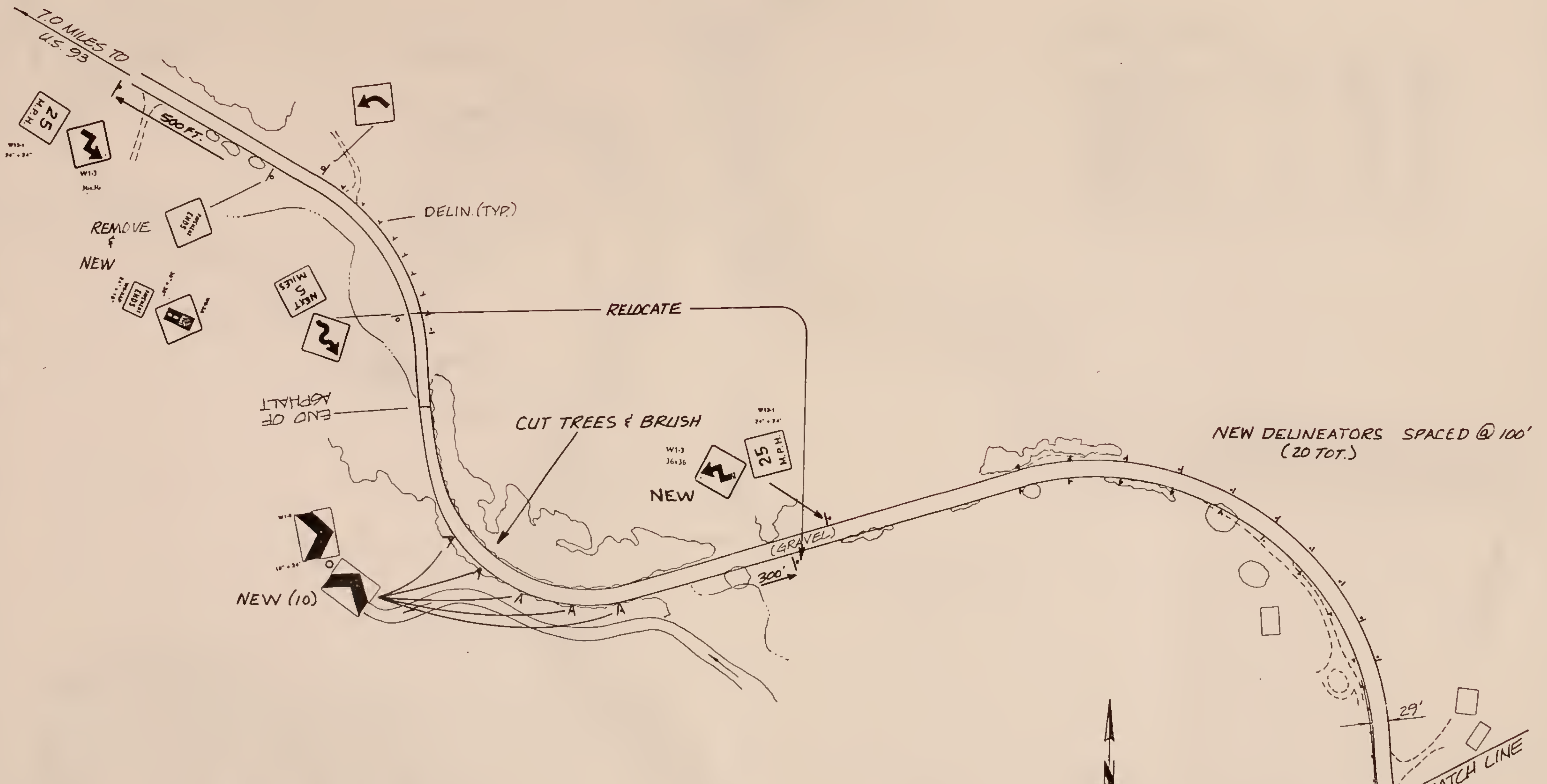
ROAD CONDITIONS - % OF TOTAL :
7 DRY = 58%
1 WET = 8%
4 ICT = 33%

LIOHT CONDITIONS - % OF TOTAL :
7 DARK = 58%
5 DAY = 42%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
6 INJURY = 50%
6 PROP DAM= 50%

ALCOHOL INVOLVED 0
% TOTAL = 0%

MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph. (406) 248-6088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: SLEEPING CHILD ROAD @ END OF PAVEMENT EXISTING CONDITIONS	Surveyed By: Designed By: Drawn By: Checked By: Date:	Revisions No. Date No. Date No. Date No. Date	Project No. Chart No.	Sheet No. 2 of

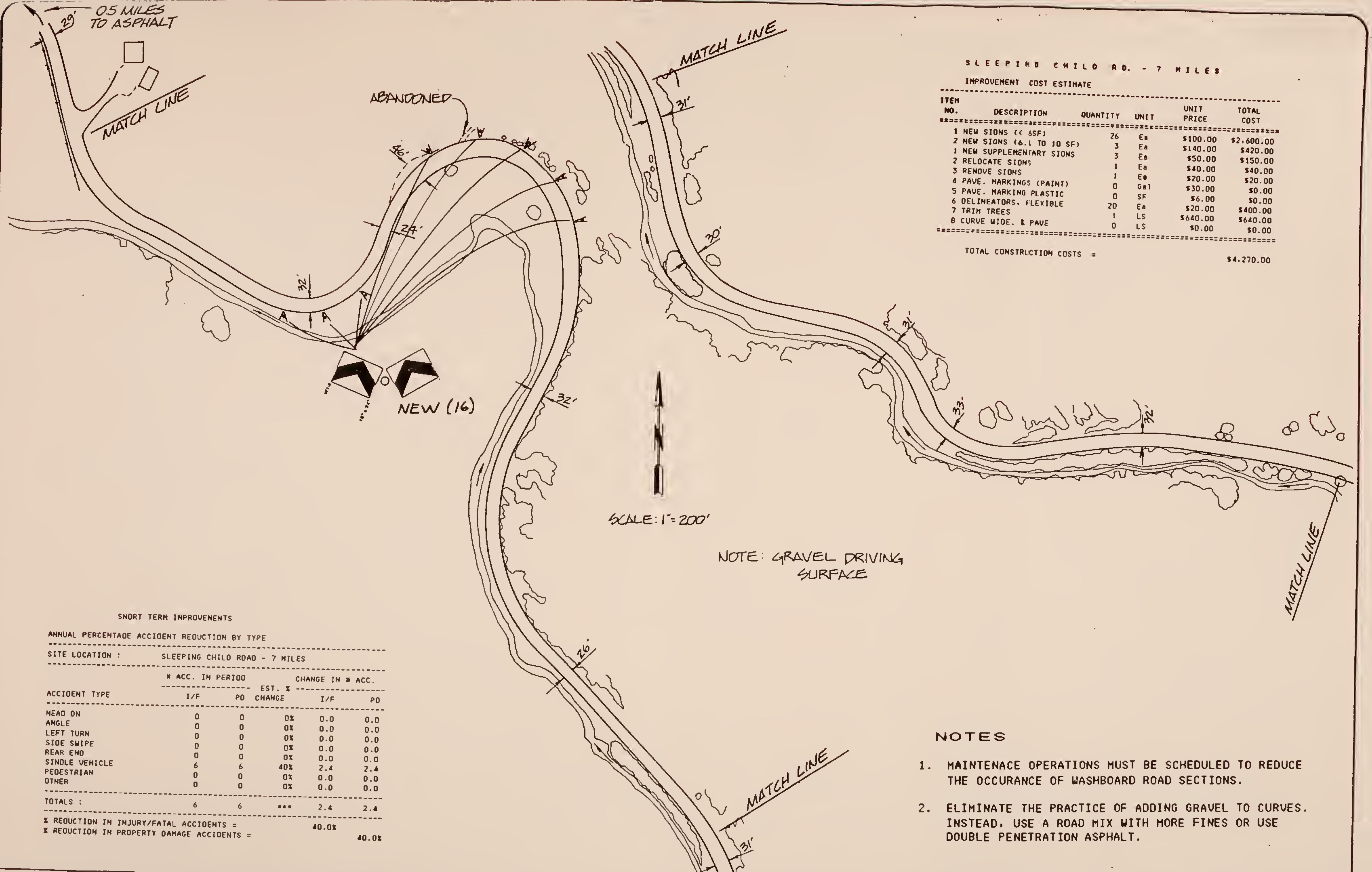


SCALE: 1"=200'

LONG TERM IMPROVEMENT

TO ELIMINATE THE PAVEMENT ENDING JUST BEFORE A SHARP CURVE, THE CURVE SHOULD BE RECONSTRUCTED AND PAVED TO A POINT APPROXIMATELY 400 FEET SOUTH OF THE CURVE. CONSTRUCTION TO COVER A TOTAL DISTANCE OF APPROXIMATELY 1,000 FEET.
APPROXIMATE COST = $ 30,000

MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph (406) 248-5066	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: SLEEPING CHILD ROAD @ END OF PAVEMENT SHORT TERM IMPROVEMENTS	Surveyed By: Designed By: Drawn By: Checked By: Date:	Sheet No. 1 of



SLEEPING CHILD RD. - 7 MILES

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (< 6SF)	26	Ea	$100.00	$2,600.00
2	NEW SIGNS (6.1 TO 10 SF)	3	Ea	$140.00	$420.00
1	NEW SUPPLEMENTARY SIGNS	3	Ea	$50.00	$150.00
2	RELOCATE SIGNS	1	Ea	$40.00	$40.00
3	REMOVE SIGNS	1	Ea	$20.00	$20.00
4	PAVE. MARKINGS (PAINT)	0	Gal	$30.00	$0.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	DELINEATORS, FLEXIBLE	20	Ea	$20.00	$400.00
7	TRIM TREES	1	LS	$640.00	$640.00
8	CURVE WIDE. & PAVE	0	LS	$0.00	$0.00

TOTAL CONSTRUCTION COSTS = $4,270.00

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : SLEEPING CHILD ROAD - 7 MILES

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	0	0%	0.0	0.0
SINGLE VEHICLE	6	6	40%	2.4	2.4
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	6	6	***	2.4	2.4

% REDUCTION IN INJURY/FATAL ACCIDENTS = 40.0%

% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 40.0%

NOTES

1. MAINTENACE OPERATIONS MUST BE SCHEDULED TO REDUCE THE OCCURANCE OF WASHBOARD ROAD SECTIONS.
2. ELIMINATE THE PRACTICE OF ADDING GRAVEL TO CURVES. INSTEAD, USE A ROAD MIX WITH MORE FINES OR USE DOUBLE PENETRATION ASPHALT.

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-6088

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: SLEEPING CHILD ROAD @ END OF PAVEMENT SHORT TERM IMPROVEMENTS

Surveyed By :
Designed By :
Drawn By :
Checked By :
Date :

Revisions
No. ___ Date ___
No. ___ Date ___
No. ___ Date ___
No. ___ Date ___

Project No.

Client No.

Sheet No.

of

SITE #2

SLEEPING CHILD RD @ BEAR CREEK
PRIORITY NUMBER 2

SITE DESCRIPTION

Sleeping Child Road is a rural mountain road which provides access to camp sites, small farms and a resort type business at the southern end of the road. It begins at an intersection with Skalkaho Road, just south of Hamilton and west of Grantsdale. It proceeds in a southeast direction for approximately 11 miles. and ends at the Sleeping Child Hot Springs parking lot. The first 6.5 miles of this road are paved , while the remainder of the road is a gravel surface. This accident site is located just north of the resort parking lot near the end of the road and is approximately 0.3 miles in length.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located at the bridge crossing of Bear Creek and at a curve east of the bridge at the bottom of a hill. The roadway going to the resort parking lot south of the first cluster area is on an 11% grade. The sharp curve is at the bottom of this grade. The remainder of the roadway west and north of this curve is on a 3% grade.

The gravel roadway ranges in width from 17 feet to 31 feet. The roadway veers from its alignment along the creek to cross a bridge which crosses the creek at a 90 degree angle. The

approach curves to this bridge are extremely sharp. Roadside vegetation infringes on the roadway all along this site and fairly well hides the course of the road.

Traffic Control Devices. The only traffic control devices in this section are a "Winding Curve -Next 5 Miles" sign for the northbound direction, hazard markers on the bridge ends, weight limit signs for the bridge and a directional arrow panel. The "Winding Curves" sign is inherently vague, but its location does nothing to warn of the immediate dangers pending. The hazard marker signs are ineffective because they are not visible until the hazard is also in plain site. The directional arrow panel is not located in line with the approaching direction of travel which further distorts the correct alignment.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 110 vehicles per day. Traffic volumes throughout the past four years have probably remained relatively constant. County counts in 1988 indicated the same level. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious conflicts were observed on this section of roadway. Traffic volumes are so low that it is difficult to determine driver and vehicle reaction to the situations encountered. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors have combined to create potential problems at this site.

1. The roadway geometrics at the bridge site are extreme in comparison to the previous section of road.

2. The bridge alignment is so radically different than the roadway that even if it could be seen in advance, the proper vehicle path could not be visualize until a driver was right at the site.

3. The downhill grade approach to the first sharp curve north of the resort is extreme even when road conditions are good. Difficulty in keeping vehicle speed low is complicated by the 90 degree curve at the bottom of the hill and the exact alignment of the roadway is not obvious since it takes a turn to the right before turning left.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were six accidents recorded in the four year study period. The accidents seem to be erratic. Two were recorded in 1985 and the remaining four were in 1988. All of the accidents were single vehicle accidents and 4 of them were directly attributable to the condition of the road surface.

The majority of accidents occurred on icy roads in fair weather conditions. Accidents were split between day and night time conditions. Property damage was the result of 5 accidents while 1 accident produced a fatality.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Proper curve warning signs indicating the degree of severity of the first curve at the bottom of the hill and at the bridge approaches is critical in this case. Proper delineation of the roadway path combined with the advanced warning will greatly aid motorists in negotiating the tricky geometrics encountered at this site. Also, removal of key trees, bushes and vegetation to give motorists an unimpeded view of the road alignment ahead will decrease the element of surprise.

As with the other Sleeping Child Road site, increased maintenance on the road surface will improve control of vehicle dynamics.

The cost of these improvements is estimated to be approximately $1,680 based on 1989 unit bid contract prices and MDOH fund eligible prices.

Long term improvements at this site are probably impractical due to the extreme topographic constraints in the area and the small volume of traffic that the road serves.

BENEFITS

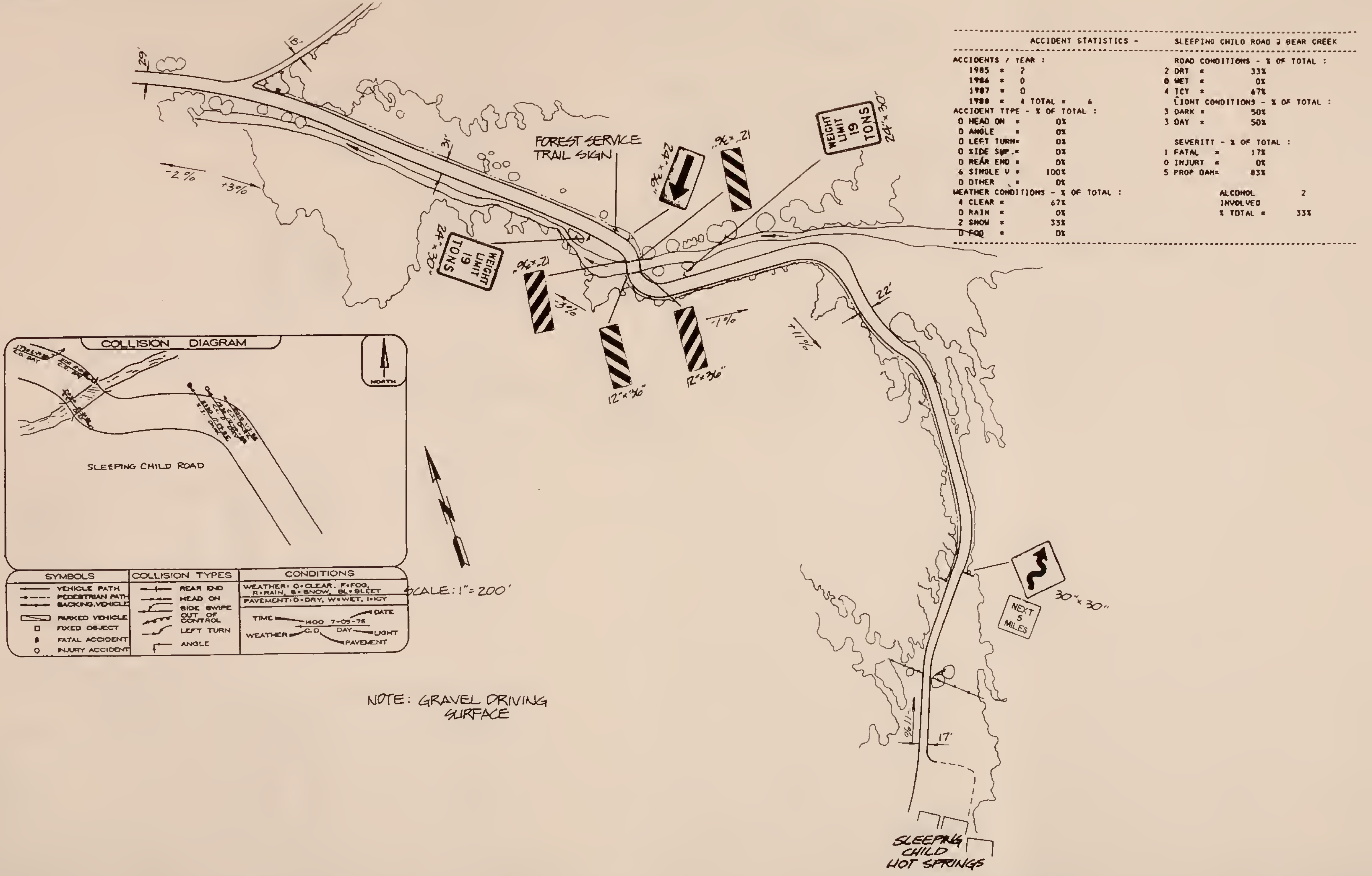
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $3,484 annually. The benefit/cost ratio is computed according to accepted methods at 6.41, which makes it a desirable project considering the low capital investment.

SLEEPING CHILD RD. BRIDGE APP, NORTHBOUND

SLEEPING CHILD RD.1ST CURVE N. LODGE, NORTHBOUND

SLEEPING CHILD RD. BRIDGE APP, SOUTHBOUND

SLEEPING CHILD RD. CURVE @ BOTTON HILL, NORTHBOUND



ACCIDENT STATISTICS - SLEEPING CHILD ROAD @ BEAR CREEK

ACCIDENTS / YEAR :	ROAD CONDITIONS - % OF TOTAL :
1985 = 2	2 DRY = 33%
1986 = 0	0 WET = 0%
1987 = 0	4 ICY = 67%
1988 = 4 TOTAL = 6	LIGHT CONDITIONS - % OF TOTAL :
ACCIDENT TYPE - % OF TOTAL :	3 DARK = 50%
0 HEAD ON = 0%	3 DAY = 50%
0 ANGLE = 0%	
0 LEFT TURN = 0%	SEVERITY - % OF TOTAL :
0 SIDE SWP. = 0%	1 FATAL = 17%
0 REAR END = 0%	0 INJURY = 0%
6 SINGLE V = 100%	5 PROP DAM = 83%
0 OTHER = 0%	
WEATHER CONDITIONS - % OF TOTAL :	ALCOHOL 2
4 CLEAR = 67%	INVOLVED
0 RAIN = 0%	% TOTAL = 33%
2 SNOW = 33%	
0 FOG = 0%	

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-5088

Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY

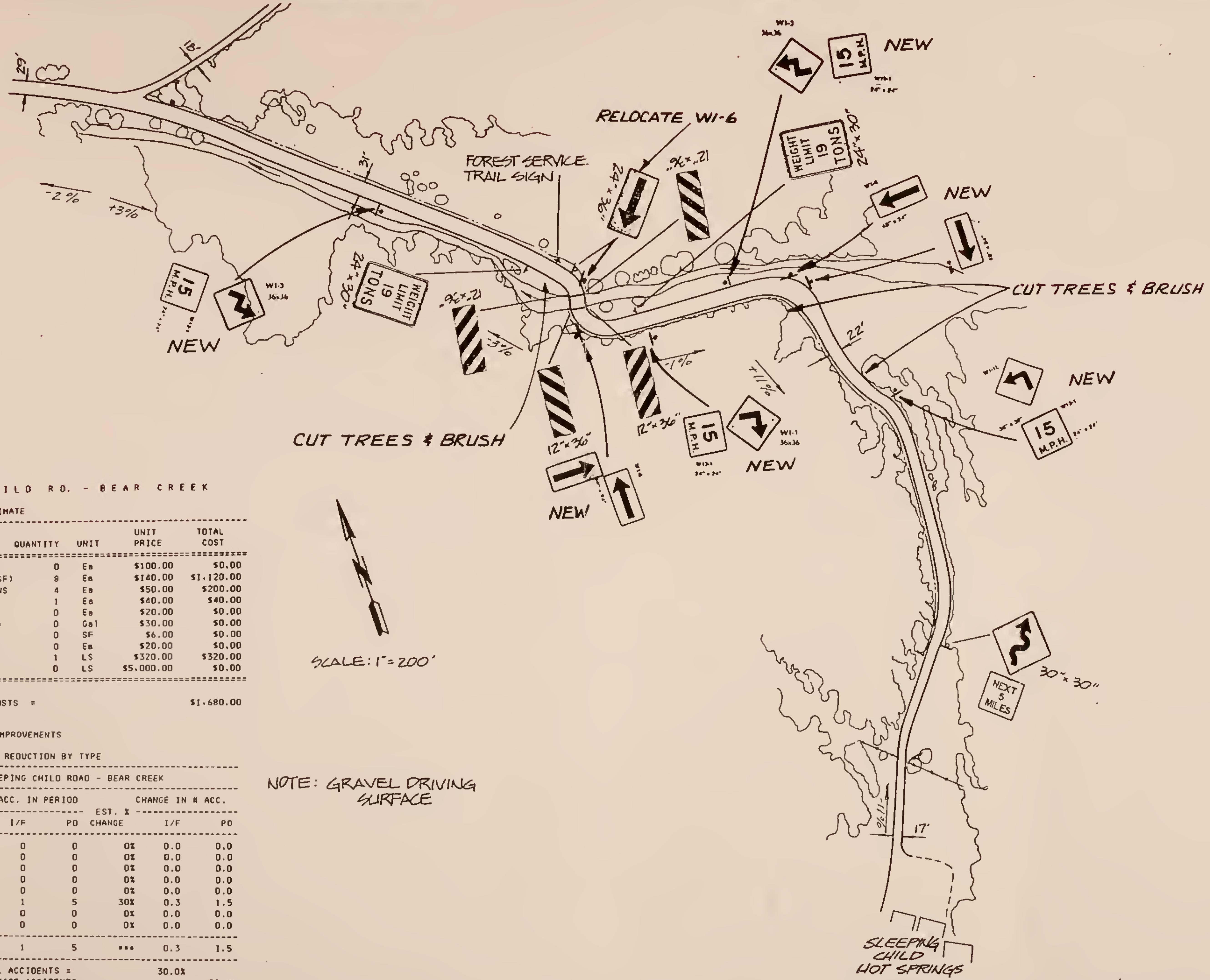
Sheet Title : SLEEPING CHILD ROAD @ BEAR CREEK EXISTING CONDITIONS

Surveyed By :
Designed By :
Drawn By :
Checked By :
Date :

Revisions
No. Date
No. Date
No. Date
No. Date

Project No
Client No.

Sheet No. 1 of



S L E E P I N O   C H I L O   R O. - B E A R   C R E E K

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIONS (< 6SF)	0	Ea	$100.00	$0.00
2	NEW SIGNS (6.I TO IO SF)	8	Ea	$140.00	$1,120.00
1	NEW SUPPLEMENTARY SIONS	4	Ea	$50.00	$200.00
2	RELOCATE SIGNS	1	Ea	$40.00	$40.00
3	REMOVE SIGNS	0	Ea	$20.00	$0.00
4	PAVE. MARKINGS (PAINT)	0	Gal	$30.00	$0.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	OELINEATORS, FLEXIBLE	0	Ea	$20.00	$0.00
7	TRIM TREES	1	LS	$320.00	$320.00
8	CURVE WIOE. & PAVE	0	LS	$5,000.00	$0.00

TOTAL CONSTRUCTION COSTS = $I,680.00

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIOENT REOUCTION BY TYPE

SITE LOCATION : SLEEPING CHILO ROAO - BEAR CREEK

ACCIOENT TYPE	# ACC. IN PERIOO I/F	# ACC. IN PERIOO PO	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PO
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIOE SWIPE	0	0	0%	0.0	0.0
REAR ENO	0	0	0%	0.0	0.0
SINGLE VEHICLE	1	5	30%	0.3	1.5
PEOESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	1	5	***	0.3	1.5

% REOUCTION IN INJURY/FATAL ACCIOENTS = 30.0%

% REOUCTION IN PROPERTY OAMAGE ACCIOENTS = 30.0%

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SITE #3

OLD DARBY ROAD - COMO LAKE ROAD
PRIORITY NUMBER 3

SITE DESCRIPTION

Old Darby Road is a rural road which winds through the foothills parallel to U.S. 93 just north of Darby. It provides access to camp sites, small farms and a recreation at Como Lake west of Old Darby Road. It begins at an intersection with U.S. 93 approximately 0.6 miles north of the Como Lake Road and proceeds south 3.7 miles until it intersects U.S. 93 once again.

The accident cluster area begins approximately 0.3 mile north of the Como Lake Road intersection and extends 1.2 miles to the south.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located primarily on the numerous curves along its alignment. Curves vary in sharpness throughout the section. The only extended sections of tangent alignment occur on the northern end of the site.

For the majority of its length, Old Darby road is a 22 foot gravel road. The southern end of the section is paved, but the horizontal alignment is similar to the gravel section. Vertical alignment can best be described as undulating with most grades never exceeding 2% except for very short distances at bridge and culvert crossings. Several small streams cross the road through

culverts and a minor bridge. Vegetation infringes on the roadway and in one case, a 24" diameter pine tree is growing within the roadway's shoulder.

Traffic Control Devices. The only traffic control devices in this section are a "One Lane Bridge" signs intersection warning signs, a stop sign on Como Lake Road and hazard markers on the bridge ends and culvert headwalls. Almost all of the signs are hidden from view by roadside vegetation. They are visible from certain perspectives but not from the point which would convey an advanced warning.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 240 vehicles per day. Traffic volumes throughout the past four years have probably remained relatively constant. County counts in 1988 showed approximately 140 vehicles per day, but no factor for 100% growth is evident. From the location and function of the road, a 240 vehicle count would be more accurate to account for all seasonal and hourly variations. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious conflicts were observed on this section of roadway other than extreme visibility problems caused by dust kicked up by traffic. Traffic volumes are so low that it is difficult to determine driver and vehicle reaction to the situations encountered. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors have combined to create potential problems at this site.

1. The roadway geometrics at the bridge site and culvert sites are extreme since the road bends and turns to approach these structures at a 90 degree angle. The mini curve sections tend to obscure vision of the approaching roadway. Vehicles normally travel in the most direct route in this area even if they have to drive on the wrong side of the road.

2. Sharp curves follow long sections of tangent in at least two locations. This situations tends to make the driver more comfortable with the roadway than he should be.

3. The washboard road surface causes complete loss of vehicle control especially on the northern end of the section.

4. The southern most curve is a compound curve combining a large radius followed by a small radius in the south bound direction which leads a driver into the sharp portion of the curve at speeds much too high for control of the vehicle.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were twelve accidents recorded in the four year study period. The

accidents seem to be increasing. None were recorded in 1985 and five each were recorded in 1987 and 1988. All but two of the accidents were single vehicle accidents while two of them were headons.

The majority of accidents occurred on dry roads in fair weather conditions. Accidents occurred mostly during the daylight hours. Property damage accidents were the major result while five accidents produced injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Proper curve warning signs indicating the degree of severity of the sharpest curves are needed. Proper delineation of the roadway path combined with the advanced warning will greatly aid motorists in negotiating the tricky geometrics encountered at this site. Also, removal of key trees, bushes and vegetation to give motorists an unimpeded view of the road alignment ahead will decrease the element of surprise and reduce the severity of single vehicle, off-road accidents . The use of supplementary road name plates on the advanced intersection warning signs, as provided for in the M.U.T.D.C. will greatly aid drivers in recognizing the location of the approach and in planning the turning maneuver.

The concrete headwalls on the culvert crossings not only present a roadside hazard, but the alignment of the road is dictated by their location. There is no effective way of signing

to prevent potential accidents in this case. Therefore, it is recommended that the headwalls be removed and culvert extensions with tapered end sections be installed. This will allow some latitude in straightening the roadway alignment and regrading the bridge approaches.

As with other gravel road sites, increased maintenance on the road surface will improve control of vehicle dynamics.

The cost of these improvements is estimated to be approximately $9,950 based on 1989 unit bid contract prices and MDOH fund eligible prices. The physical reconstruction should be much less if county crews performed the work.

Long term improvements at this site are probably impractical due to the extreme topographic constraints in the area and the small volume of traffic that the road serves.

BENEFITS

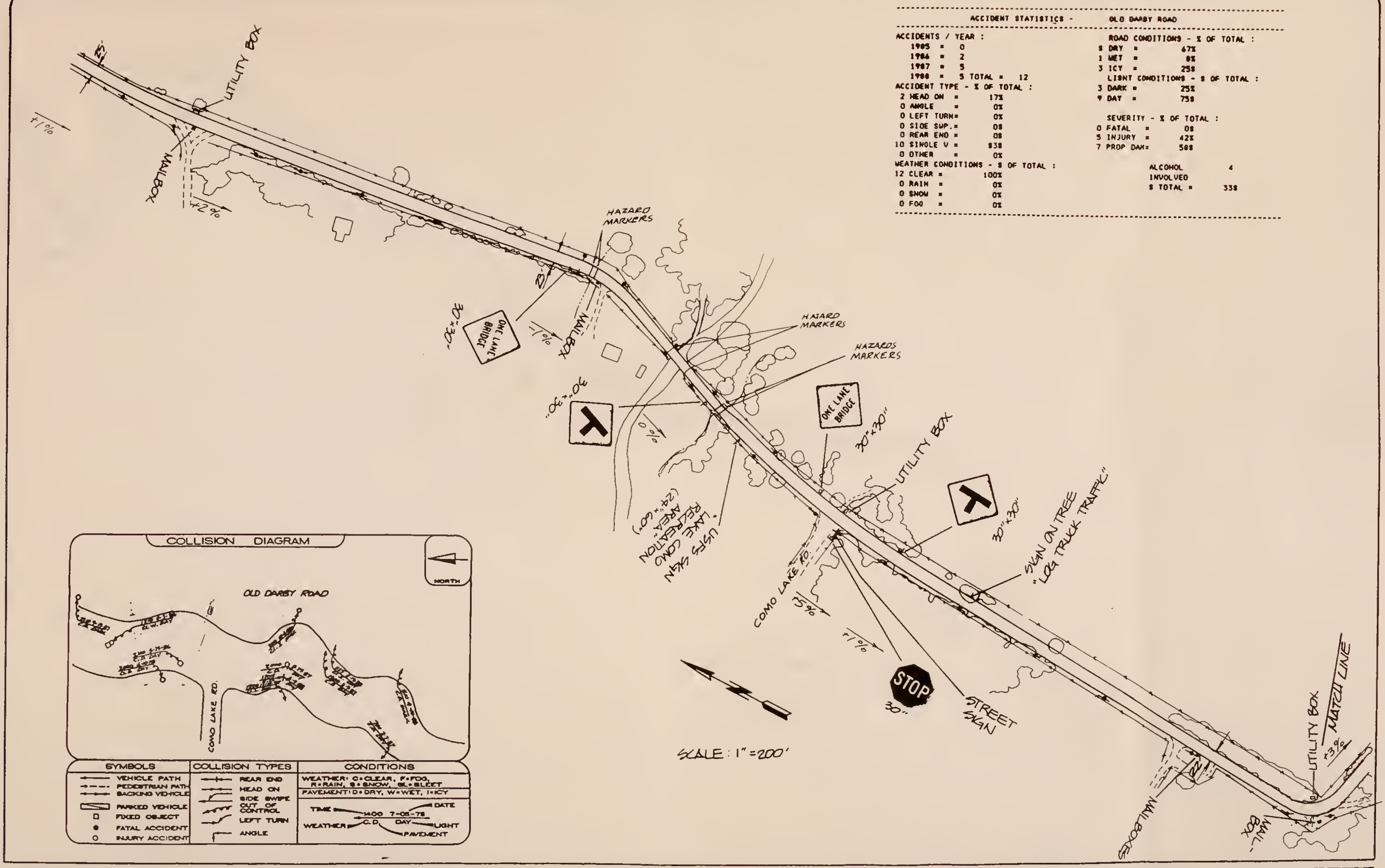
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $14,620 annually. The benefit/cost ratio is computed according to accepted methods at 7.56, which makes it a very desirable project.

OLD DARBY ROAD - COMO ROAD, SOUTHBOUND

OLD DARBY ROAD CREEK X-ING, NORTHBOUND

OLD DARBY ROAD S. OF INTER, NORTHBOUND

OLD DARBY ROAD CREEK X-ING, SOUTHBOUND



ACCIDENT STATISTICS - OLD DARBY ROAD

ACCIDENTS / YEAR :
1985 = 0
1986 = 2
1987 = 5
1988 = 5 TOTAL = 12

ACCIDENT TYPE - % OF TOTAL :
2 HEAD ON = 17%
0 ANGLE = 0%
0 LEFT TURN= 0%
0 SIDE SWP.= 0%
0 REAR END = 0%
10 SINGLE V = 83%
0 OTHER = 0%

WEATHER CONDITIONS - % OF TOTAL :
12 CLEAR = 100%
0 RAIN = 0%
0 SNOW = 0%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
8 DRY = 67%
1 WET = 8%
3 ICY = 25%

LIGHT CONDITIONS - % OF TOTAL :
3 DARK = 25%
9 DAY = 75%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
5 INJURY = 42%
7 PROP DAM= 58%

ALCOHOL INVOLVED 4
% TOTAL = 33%

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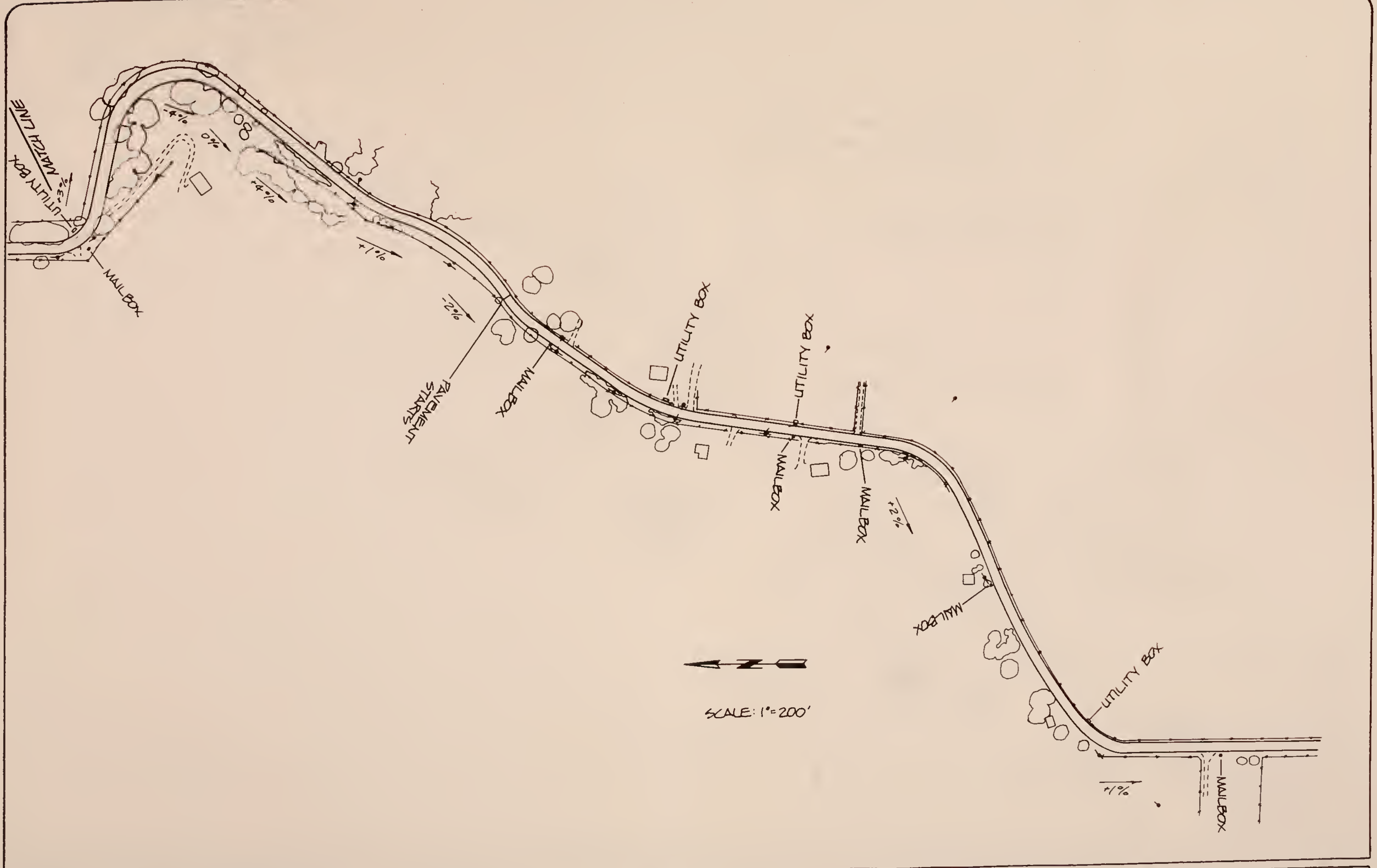

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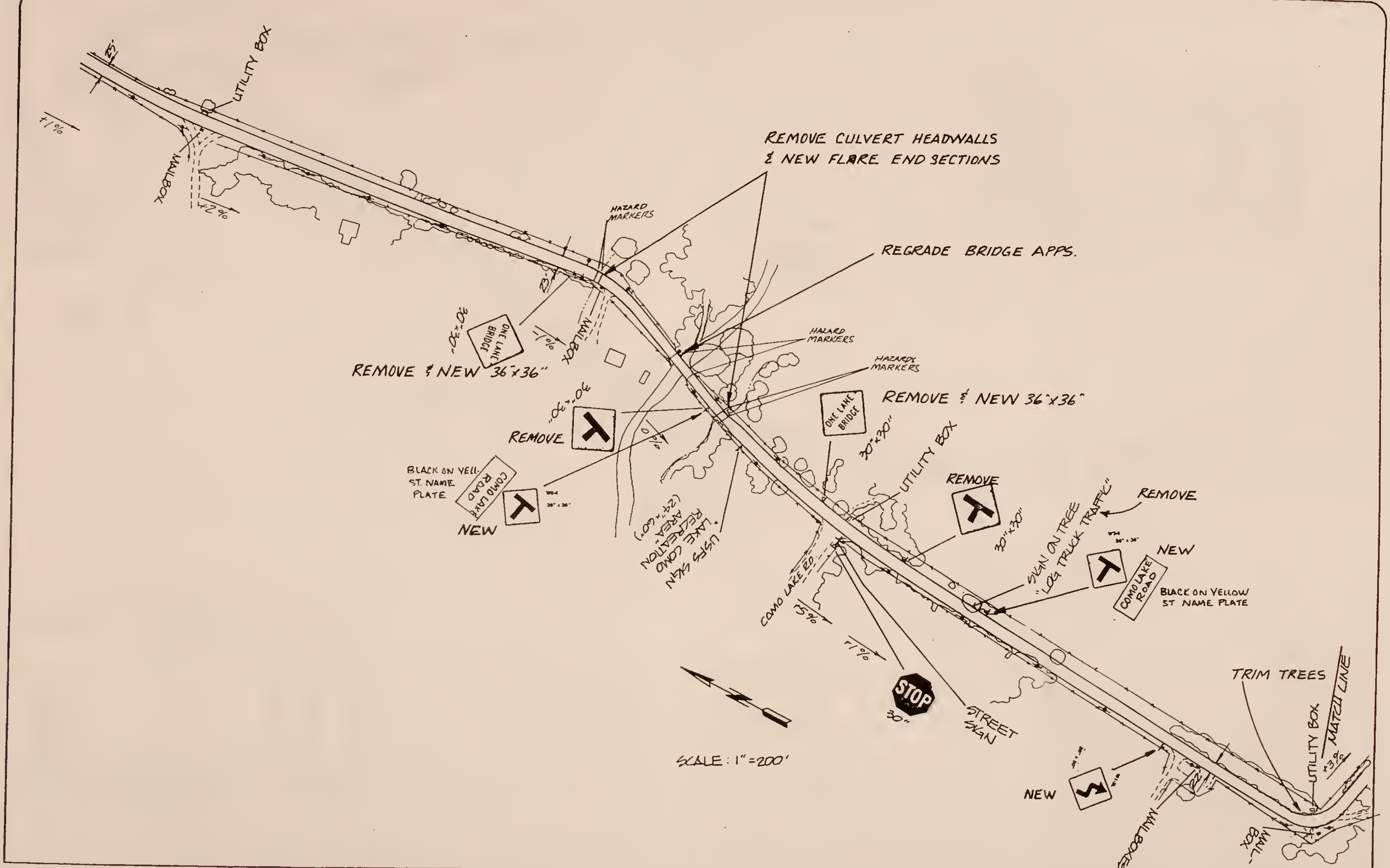

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Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph (406) 248-6068

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: OLD DARBY ROAD - COMO RD SHORT TERM IMPROVEMENTS

Surveyed By:
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Drawn By:
Checked By:
Date:

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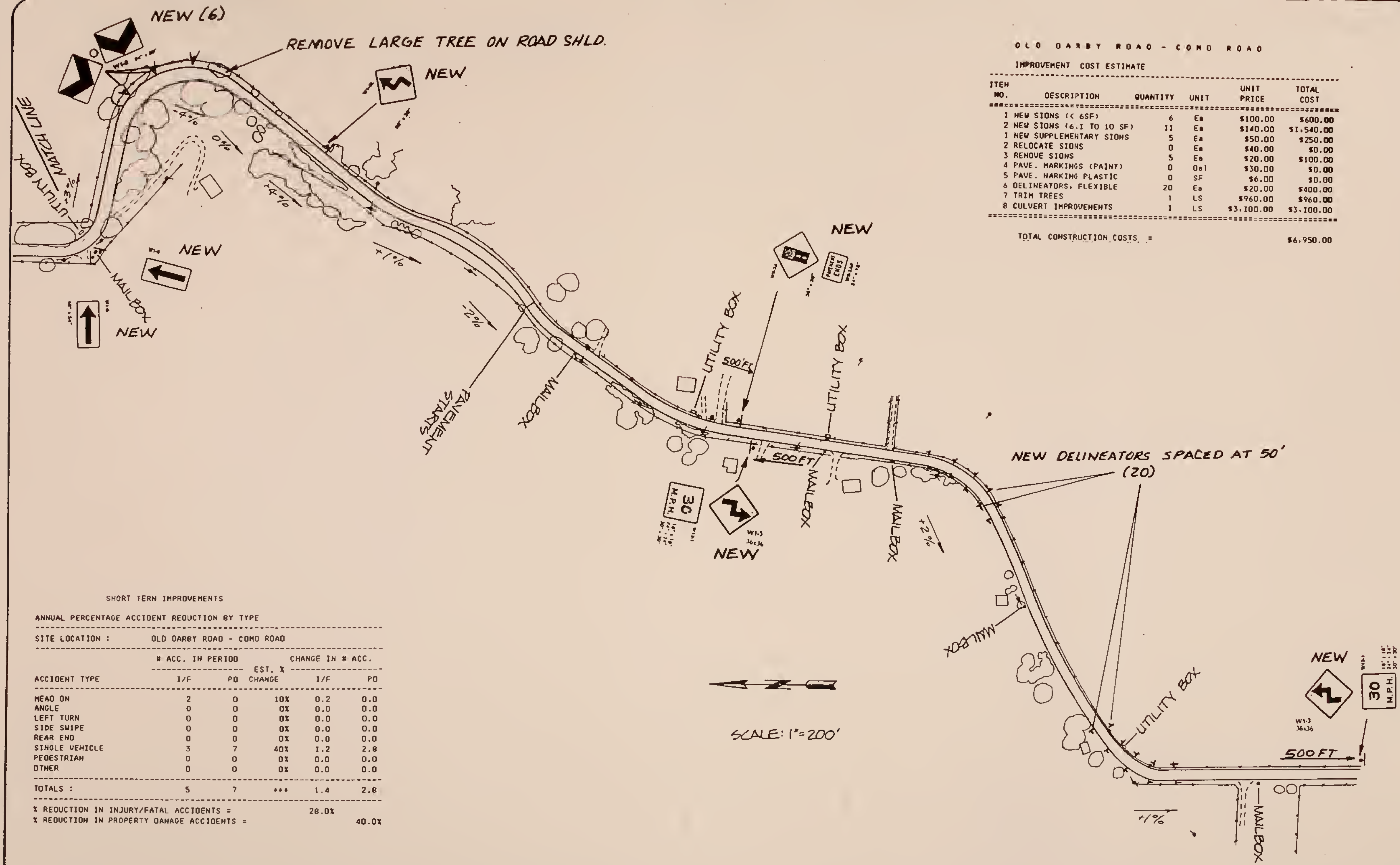

OLD DARBY ROAD - COMO ROAD

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (< 6SF)	6	Ea	$100.00	$600.00
2	NEW SIGNS (6.1 TO 10 SF)	11	Ea	$140.00	$1,540.00
1	NEW SUPPLEMENTARY SIGNS	5	Ea	$50.00	$250.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	5	Ea	$20.00	$100.00
4	PAVE. MARKINGS (PAINT)	0	Gal	$30.00	$0.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	DELINEATORS, FLEXIBLE	20	Ea	$20.00	$400.00
7	TRIM TREES	1	LS	$960.00	$960.00
8	CULVERT IMPROVEMENTS	1	LS	$3,100.00	$3,100.00

TOTAL CONSTRUCTION COSTS = $6,950.00

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : OLD DARBY ROAD - COMO ROAD

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	2	0	10%	0.2	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	0	0%	0.0	0.0
SINGLE VEHICLE	3	7	40%	1.2	2.8
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	5	7	***	1.4	2.8

% REDUCTION IN INJURY/FATAL ACCIDENTS = 28.0%

% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 40.0%

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-5088

Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title : OLD DARBY ROAD - COMO RD SHORT TERM IMPROVEMENTS

Surveyed By :
Designed By :
Drawn By :
Checked By :
Date :

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SITE #4

AMBROSE ROAD
PRIORITY NUMBER 4

SITE DESCRIPTION

Ambrose Road is a rural east-west road which is located approximately 3 miles north of Stevensville. It provides access to farms, rural residences and forested areas east of the site. It begins at an intersection with the Eastside Highway ,FAS 203, at its western terminus and extends eastward for approximately 10 miles where it ends in the Bitteroot National Forest.

The accident cluster area begins approximately 0.5 miles east of the Eastside Highway. It covers a length of approximately 1.5 miles and includes three primary intersections in its length.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located primarily on the reverse curve alignment and at intersections. The roadway is paved 24 feet in width and has variable shoulder widths and ditch slopes. In the middle of the section the tangent roadway section veers from its location on the south side of a power line to a location on the north side of the power line. This alignment jog apparently exists because of a creek bed that meanders to the north in this area.

There are numerous access points to Ambrose Road within this section. Three main intersections exist at Tripp Lane, Illinois-

Bench Road and Hoover Lane. Tripp Lane is a "T" intersection while Hoover and Illinois- Bench are four legged intersections. The Hoover Lane intersection occurs in the middle of a reverse curve. Vegetation growth at this intersection presents the most severe sight distance restriction throughout the section. However, ground vegetation along the roadway is tall enough to restrict line of sight at other locations in this site.

The approach roads have gravel surfaces. The gravel abuts the paved shoulder of Ambrose Road. This situation causes gravel to kick onto the paved surface of Ambrose Road. Ambrose Road pavement is especially irregular in these intersection areas.

Traffic Control Devices. The only traffic control devices in this section are stop signs at the road approaches, curve warning signs with supplementary plates at the reverse curves and a speed limit sign. No pavement markings are visible in the area.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 690 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4%. County counts in 1988 showed approximately 113 vehicles per day, near the eastern terminus of the road, at least five miles east of the site. From the location and function of the road, a 690 vehicle count would be accurate to account for all seasonal and hourly variations. The directional split on this roadway is approximately 40%-60% which means that at certain

periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. Serious potential conflicts were observed on this section of roadway during the field review. Also, from the Engineer's perspective during subjective evaluations at the site, it was noted that several factors have combined to create potential problems at this site.

1. The jog in the alignment presents a critical miscue to drivers. The roadside environment, the tangent alignment and flat road surface all combine to present an illusion that the road continues straight. This illusion over shadows any of the signing in place. The signing only warns of curves ahead. The judgement of when it curves is left entirely to the driver's perception of physical cues. This is extremely critical at night.

2. The intersection at Hoover Lane is not only over grown with vegetation, but its location in the reverse curve creates sight distance problems.

3. Gravel on the road surface occurs at the intersections where turning movements and other road surface, friction dependent maneuvers are made. Stopping ability is severely affected.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were nine accidents recorded in the four year study period. The accidents seem to be fairly constant with an average over 2 per year. the predominant accident type was single vehicle accidents.

Three angle accidents occurred and one head-on.

The majority of accidents occurred on dry roads in fair weather conditions. Accidents occurred mostly during the night time hours. The severity of accidents at this site is quite high with 78% of the accidents producing injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Over sized curve warning signs are considered necessary to draw more attention in advance of the curves. Proper delineation of the roadway path is especially critical at this site. Pavement markings combined with delineators will over come the other physical roadway alignment cues under most circumstances.

Removal of key trees, bushes and vegetation to give motorists an unimpeded view of the road alignment and approaching traffic as view from the side roads and driveways will decrease the potential risk of entering traffic. Advanced intersection warning and oversized stop signs will better define the intersection control for side road traffic. Use of supplementary road name plates on the advanced intersection warning signs, as provided for in the M.U.T.D.C. will greatly aid drivers in recognizing the location of the approach and in planning the turning maneuver.

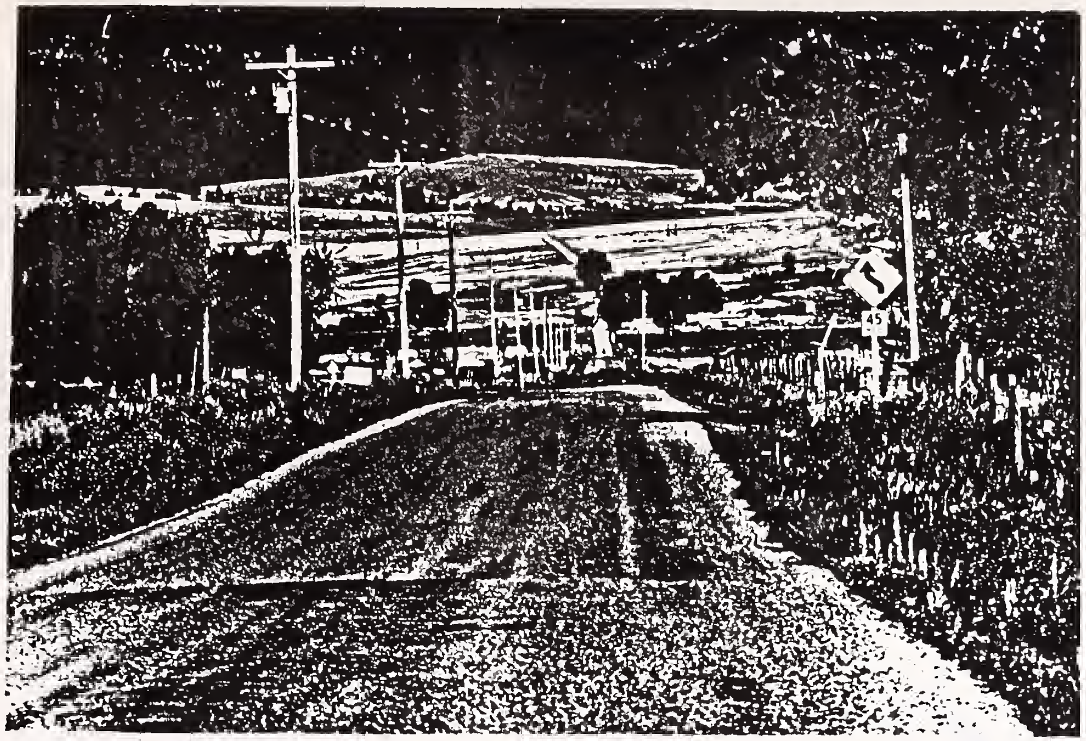
Paving the road approaches for a short distance will help keep the main roadway free of gravel and debris in the intersection areas and provide additional cues to drivers that they are approaching a controlled intersection.

The cost of these improvements is estimated to be approximately $8,290 based on 1989 unit bid contract prices and MDOH fund eligible prices. The paving and pavement markings should be much less if county crews performed the work and the striping were to be completed as part of a county wide pavement marking program.

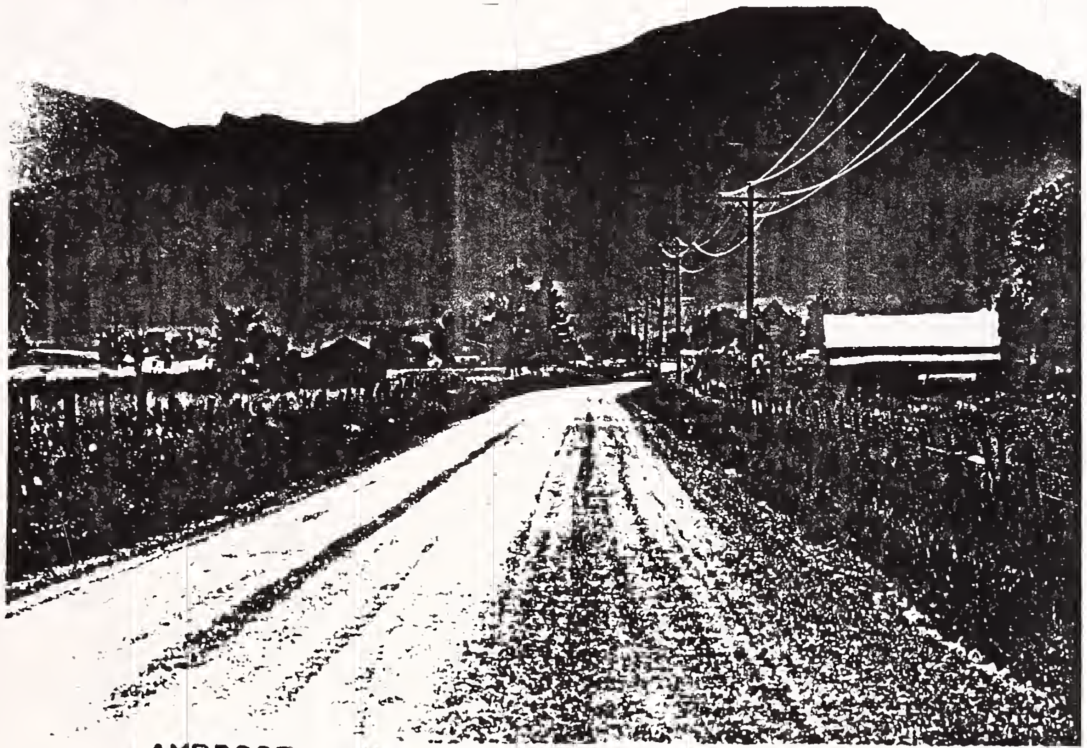
Long term improvements at this site would involve reconstructing the reverse curves with minimum radii of 1,000 feet. Very little right-of-way would be required to accomplish this solution. The long term improvement should be considered necessary if traffic volumes begin to exceed 1,000 ADT.

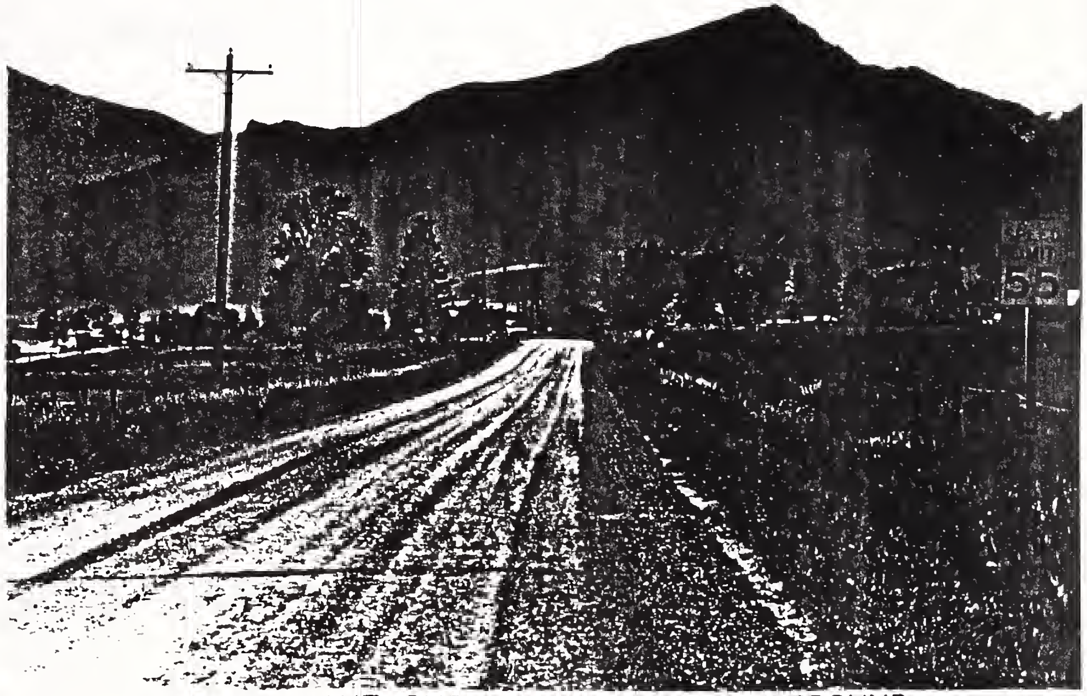
BENEFITS

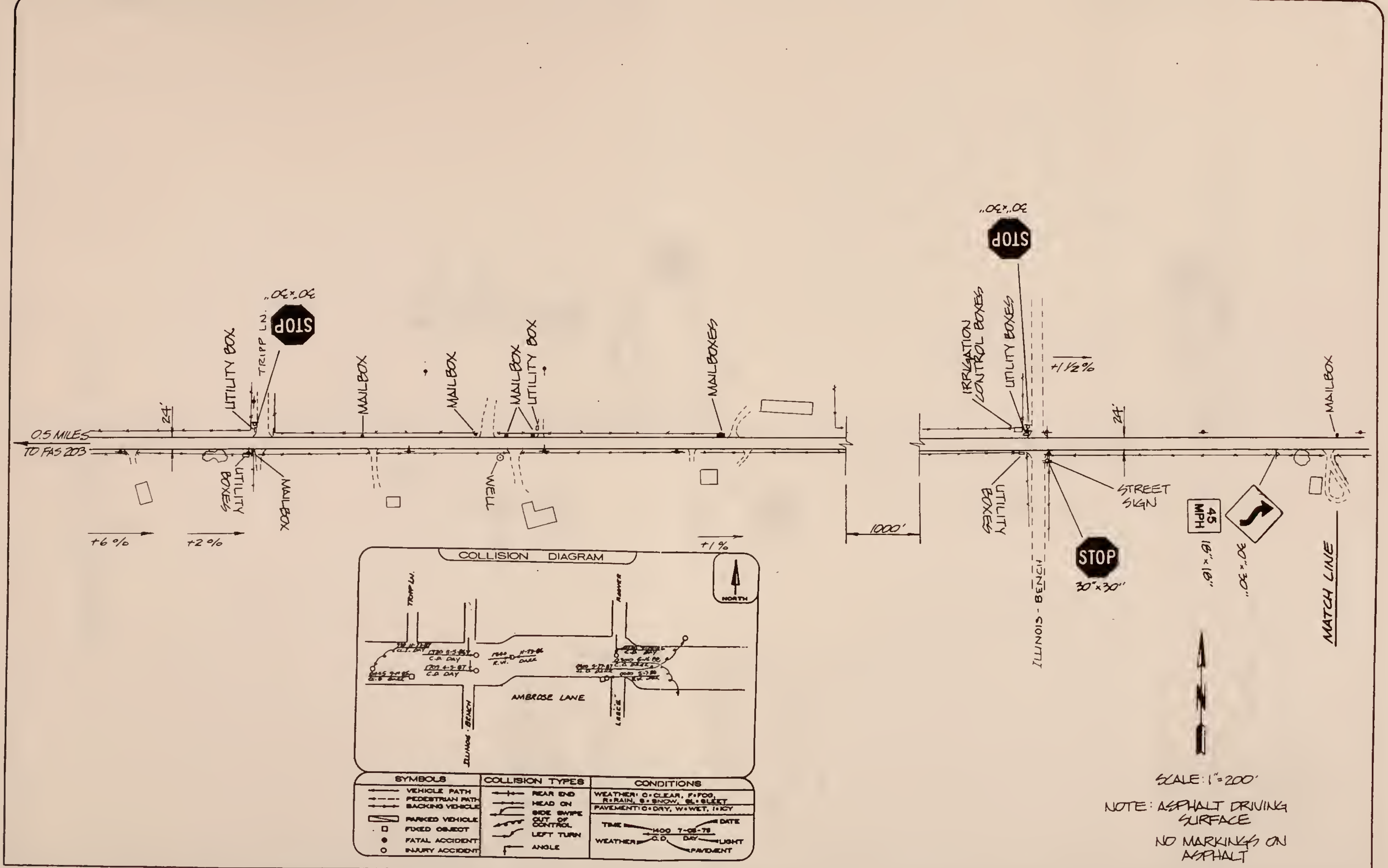
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $23,192 annually. The benefit/cost ratio is computed according to accepted methods at 10.14, second highest of all study sites.


AMBROSE LANE 1ST "S" CURVE, EASTBOUND


AMBROSE LANE 2ND "S" CURVE, EASTBOUND


AMBROSE LANE 1ST "S" CURVE, WESTBOUND


AMBROSE LANE 2ND "S" CURVE, WESTBOUND



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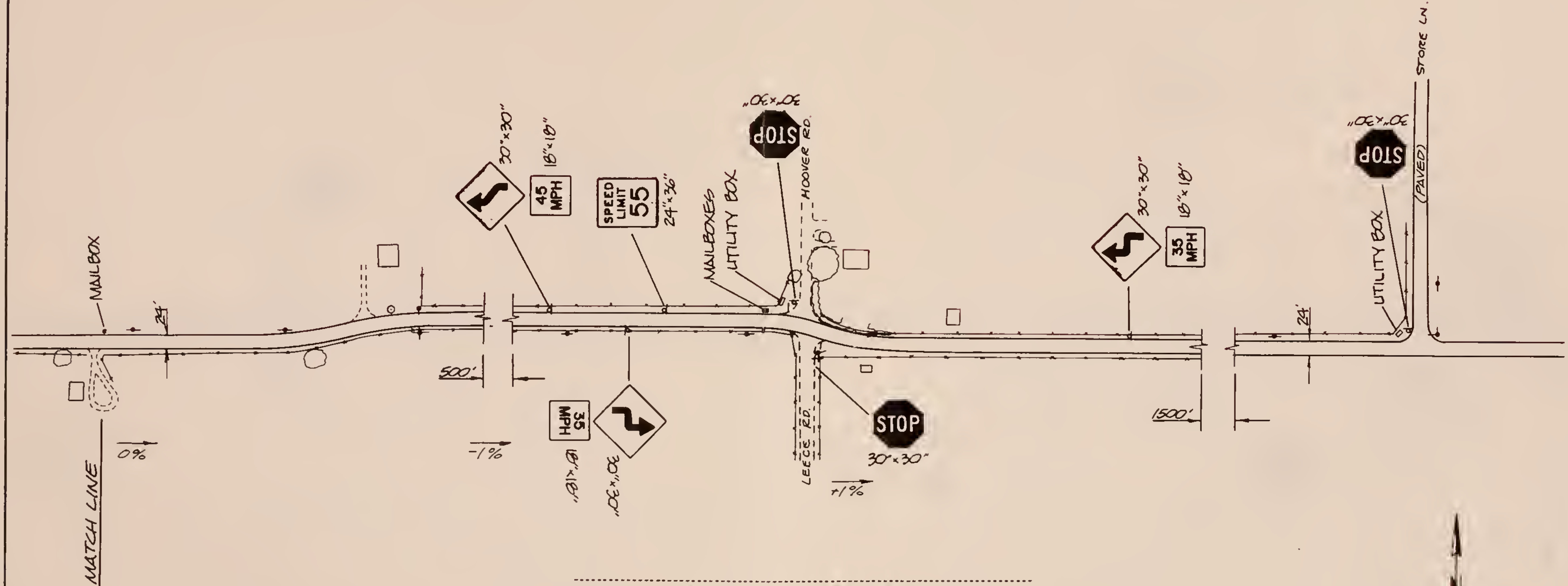

ACCIDENT STATISTICS - AMBROSE LANE

ACCIDENTS / YEAR :
1985 = 1
1986 = 3
1987 = 3
1988 = 2 TOTAL = 9

ACCIDENT TYPE - % OF TOTAL :
1 HEAD ON = 11%
3 ANGLE = 33%
0 LEFT TURN = 0%
0 SIDE SWP. = 0%
0 REAR END = 0%
4 SINGLE V = 44%
1 OTHER = 11%

WEATHER CONDITIONS - % OF TOTAL :
7 CLEAR = 78%
2 RAIN = 22%
0 SNOW = 0%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
6 DRY = 67%
2 WET = 22%
1 ICY = 11%

LIGHT CONDITIONS - % OF TOTAL :
5 DARK = 56%
4 DAY = 44%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
7 INJURY = 78%
2 PROP DAM = 22%

ALCOHOL INVOLVED 3
% TOTAL = 33%

SCALE: 1" = 200'

NOTE: ASPHALT DRIVING SURFACE

NO MARKINGS ON ASPHALT

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-6086

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: AMBROSE ROAD EXISTING CONDITIONS

Surveyed By:
Designed By:
Drawn By:
Checked By:
Date:

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No. Date
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No. Date

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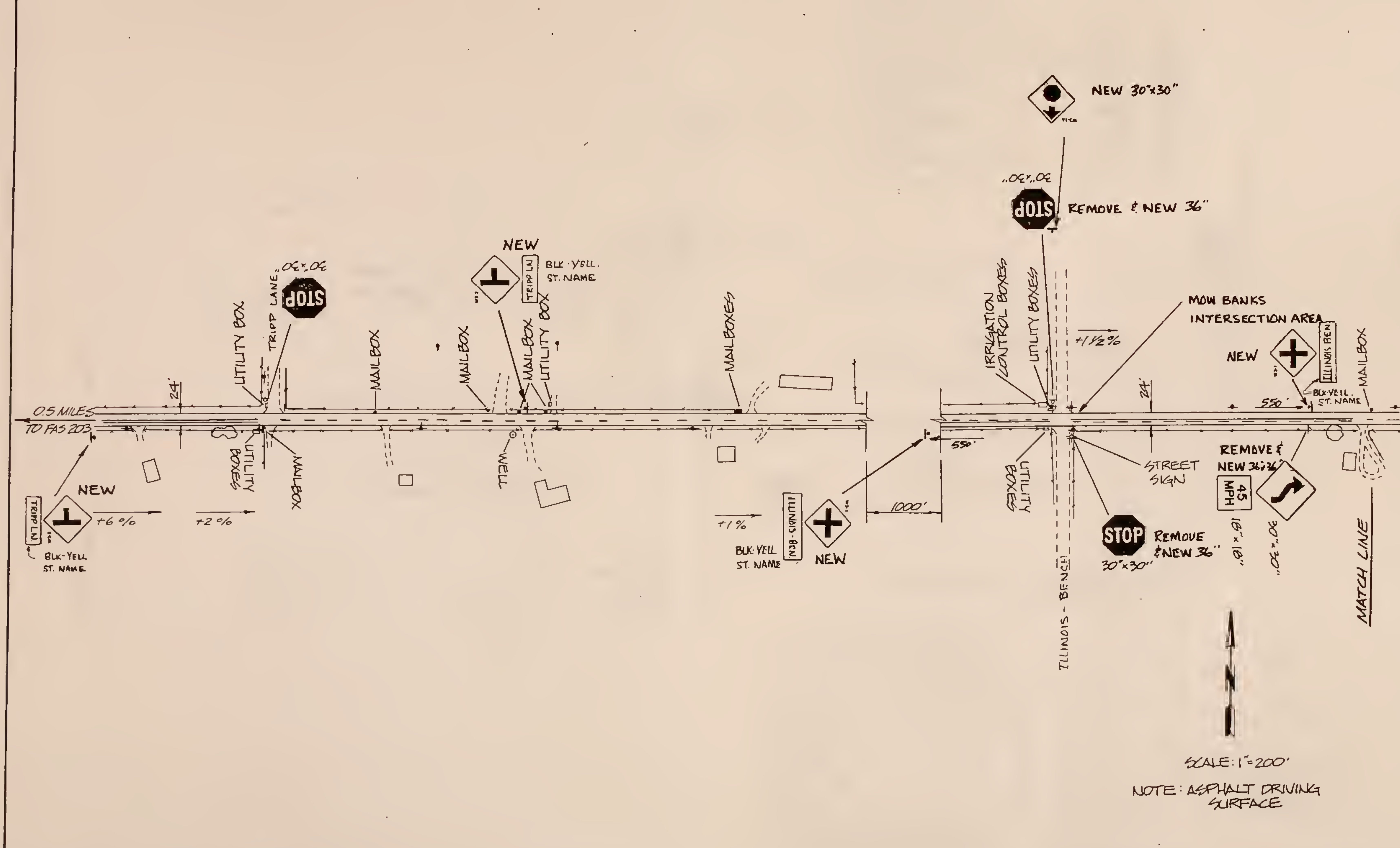

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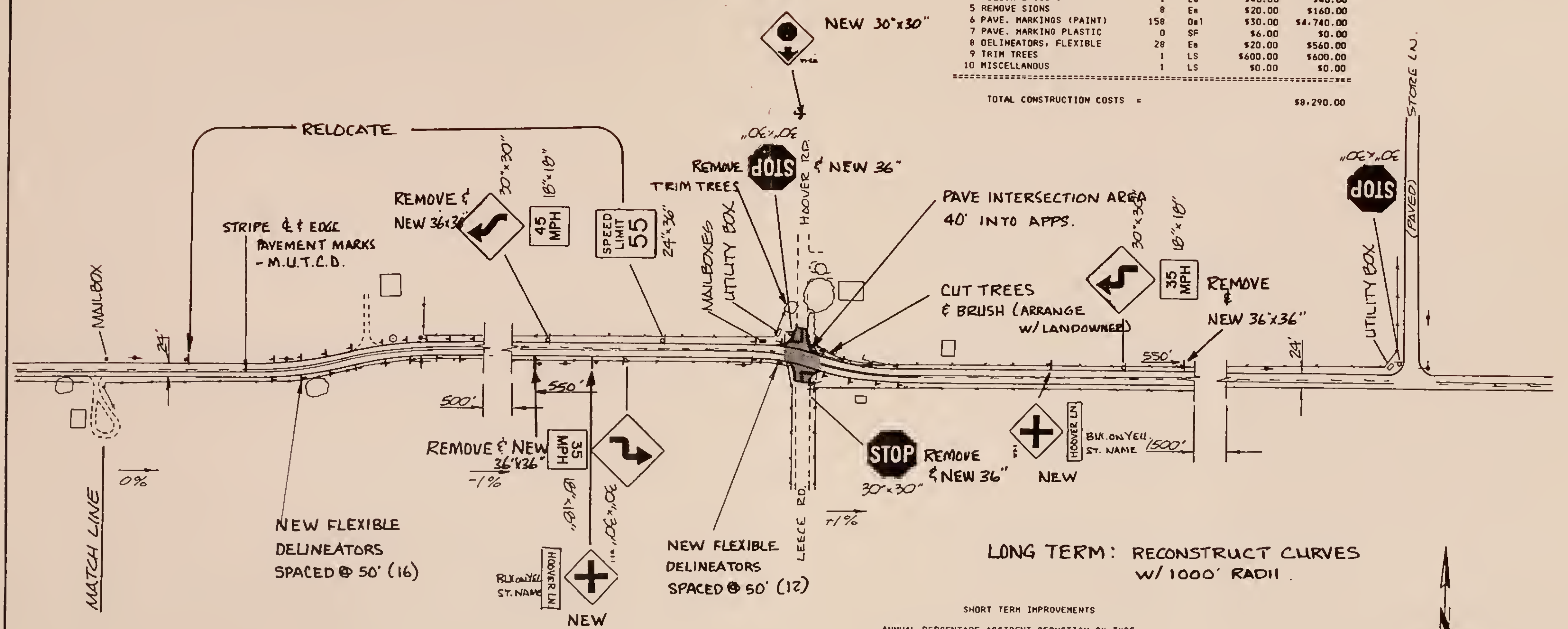
AMBROSE LANE

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (<6 SF)	2	Ea	$100.00	$200.00
2	NEW SIGNS (6.1 TO 10 SF)	11	Ea	$140.00	$1,540.00
3	NEW SUPPLEMENTARY SIGNS	9	Ea	$50.00	$450.00
4	RELOCATE SIGNS	1	Ea	$40.00	$40.00
5	REMOVE SIGNS	8	Ea	$20.00	$160.00
6	PAVE. MARKINGS (PAINT)	158	Gal	$30.00	$4,740.00
7	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
8	DELINEATORS, FLEXIBLE	28	Ea	$20.00	$560.00
9	TRIM TREES	1	LS	$600.00	$600.00
10	MISCELLANOUS	1	LS	$0.00	$0.00

TOTAL CONSTRUCTION COSTS = $8,290.00



LONG TERM: RECONSTRUCT CURVES W/ 1000' RADII.

SCALE: 1" = 200'

NOTE: ASPHALT DRIVING SURFACE

NO MARKINGS ON ASPHALT

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : AMBROSE CREEK ROAD

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	1	0	30%	0.3	0.0
ANGLE	3	0	30%	0.9	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	0	0%	0.0	0.0
SINGLE VEHICLE	3	1	40%	1.2	0.4
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	1	10%	0.0	0.1
TOTALS :	7	2	***	2.4	0.5

% REDUCTION IN INJURY/FATAL ACCIDENTS = 34.3%

% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 25.0%

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-5088

Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title : AMBROSE ROAD SHORT TERM IMPROVEMENTS

Surveyed By :
Designed By :
Drawn By :
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SITE #5

PLEASANT VIEW ROAD
PRIORITY NUMBER 5

SITE DESCRIPTION

Pleasant View Road is a rural road which is located just southwest of Victor. It provides access to farms, rural residences and forested areas west of the site. It begins west of Victor and runs in a southwest direction to an intersection with Red Crow Road, a distance of approximately 2 miles.

The accident cluster area begins approximately 0.3 miles west of an intersection with Fifth Avenue in Victor and ends approximately 0.6 miles west. An intersection with Middle Bear Creek Road is within the cluster site.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located primarily on two curve sections of roadway. The roadway has 24 foot wide pavement and has variable shoulder widths and ditch slopes. There are three horizontal curves in the study section even though only two of the curves have accident experience. All three of the curves have similar vehicle operating characteristics. Grades range from 7% to 0%. One vertical curve at the beginning of the study area has very limited sight distance. The roadside environment is devoid of forest in the eastern 2/3 of the section

while the western section is in heavy forest. Single trees along the road do present fix object hazards and vision obstructions.

Traffic Control Devices. There are no traffic control devices in this section other than street name signs. No pavement markings are visible in the area.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 460 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4%. County counts in 1988 showed approximately 182 vehicles per day, far to the west of the site. Recording traffic counters were set out on this road and calibrated. From this, the 460 number was verified. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. Serious potential operations problems were observed on this section of roadway during the field review. Also, from the Engineer's perspective during subjective evaluations at the site, it was noted that several factors have combined to create potential problems at this site.

1. The first horizontal curve on the east end of the site is sharp and is combined with a sag vertical curve. The tangent continuation of the southbound alignment becomes a gravel approach road. The curve is narrow and difficult to traverse without

entering the opposing lane.

2. The sharp crest vertical curve on the east end of the sight not only has reduce stopping sight distance, but it severe enough to cause a vehicle to become airborne at higher speeds.

3. The Middle Bear Creek Road intersection occurs on the outside of the second horizontal curve. Sight distance on the inside of the curve is blocked by a tree and the road embankment. It is extremely difficult to see the intersection configuration from either approach direction.

4. The last curve in the series is visually deceptive. The degree of sharpness is much greater than perceived on a drivers approach to the curve.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were five accidents recorded in the four year study period. The accidents seem to be erratic with 2 occurring in 1985 and 2 in 1988. The type of accidents were single vehicle accidents.

The majority of accidents occurred in fair weather conditions, but they were split between dry and icy roads. Accidents occurred predominantly during the night time hours. The severity of accidents at this site is higher than normal with 60% of the accidents producing injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Curve warning signs are considered necessary in advance of the curves to provide adequate warning of the unexpected conditions. Proper delineation of the roadway path is especially critical at this site. Pavement markings combined with delineators will provide adequate visual clues as to the proper vehicle path.

Removal of the tree and reshaping of the road embankment should open up the view of the intersection geometrics and give motorists an unimpeded view of the road alignment and approaching traffic. Use of supplementary road name plates on the advanced intersection warning signs, as provided for in the M.U.T.D.C. will greatly aid drivers in recognizing the location of the approach and in planning the turning maneuver. A stop sign should be placed on the side road to control right of way at the intersection.

Realigning the gravel approach road on the east side of the site will allow proper delineation of the main road curvature and control the speed and angle of approaching traffic from the side approach.

The cost of these improvements is estimated to be approximately $8,120 based on 1989 unit bid contract prices and MDOH fund eligible prices. The grading and pavement markings should be much less if county crews performed the work and the striping were to be completed as part of a county wide pavement marking program.

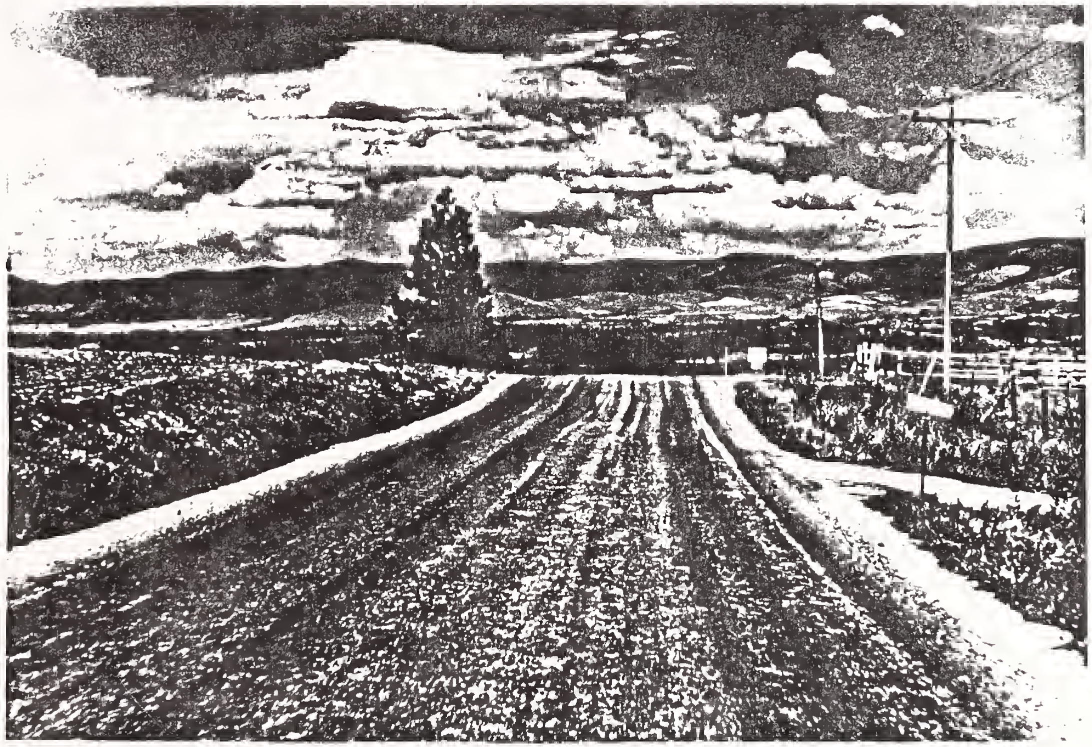
Long term improvements at this site would involve reconstructing the curves with minimum radii of 800 feet and reconstructing the vertical curve to provide adequate stopping sight distance. Some right-of-way would be required to accomplish this solution. The long term improvement should be considered necessary if traffic volumes begin to exceed 2,000 ADT.

BENEFITS

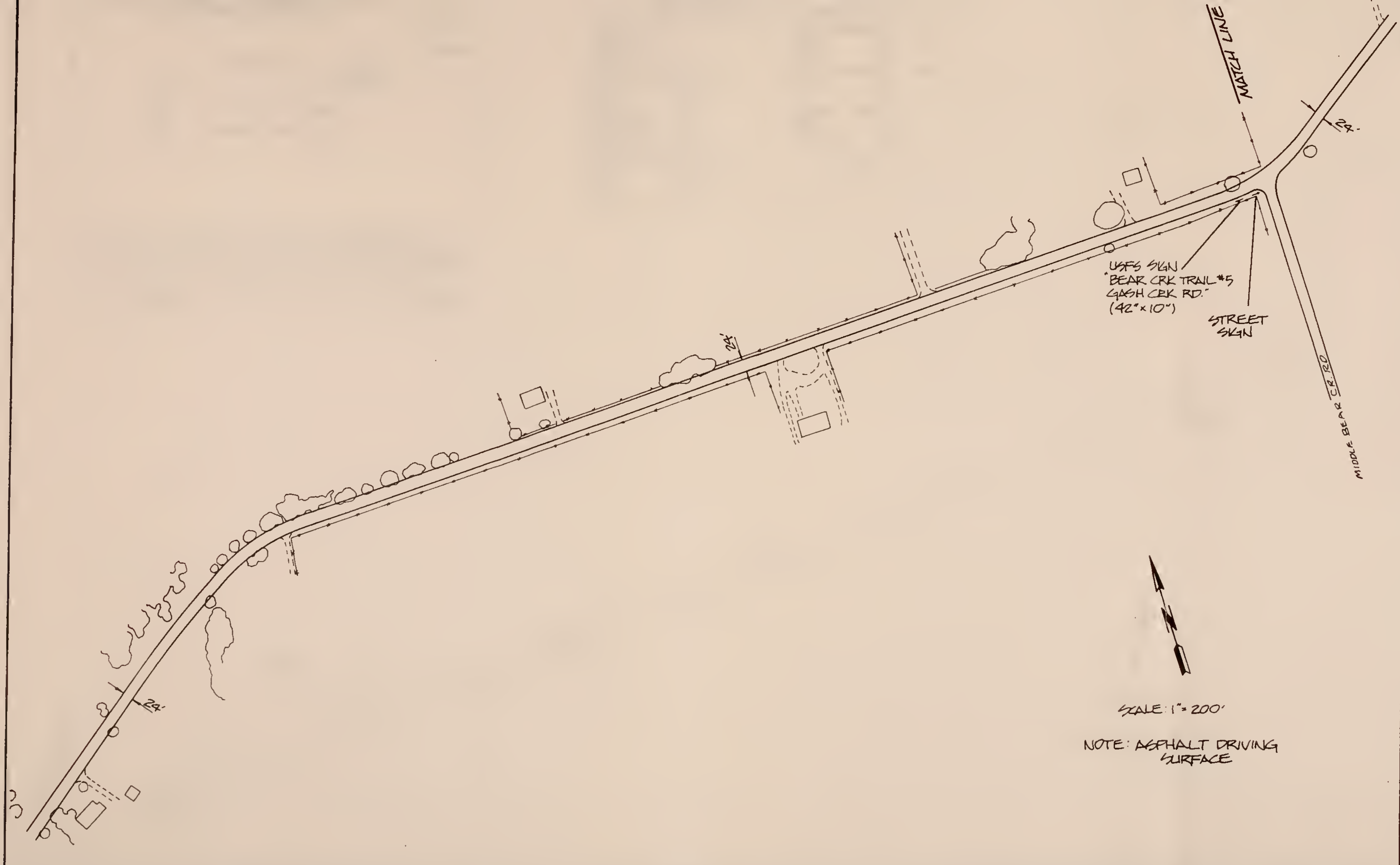
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $11,907 annually. The benefit/cost ratio is computed according to accepted methods at 5.19, which makes it a good investment in the economy of Ravalli County.


PLEASANT VIEW RD @ MID BEAR CR, EASTBOUND


PLEASANT VIEW RD @ MID BEAR CR, WESTBOUND


PLEASANT VIEW RD EAST END, EASTBOUND


PLEASANT VIEW RD WEST END, WESTBOUND



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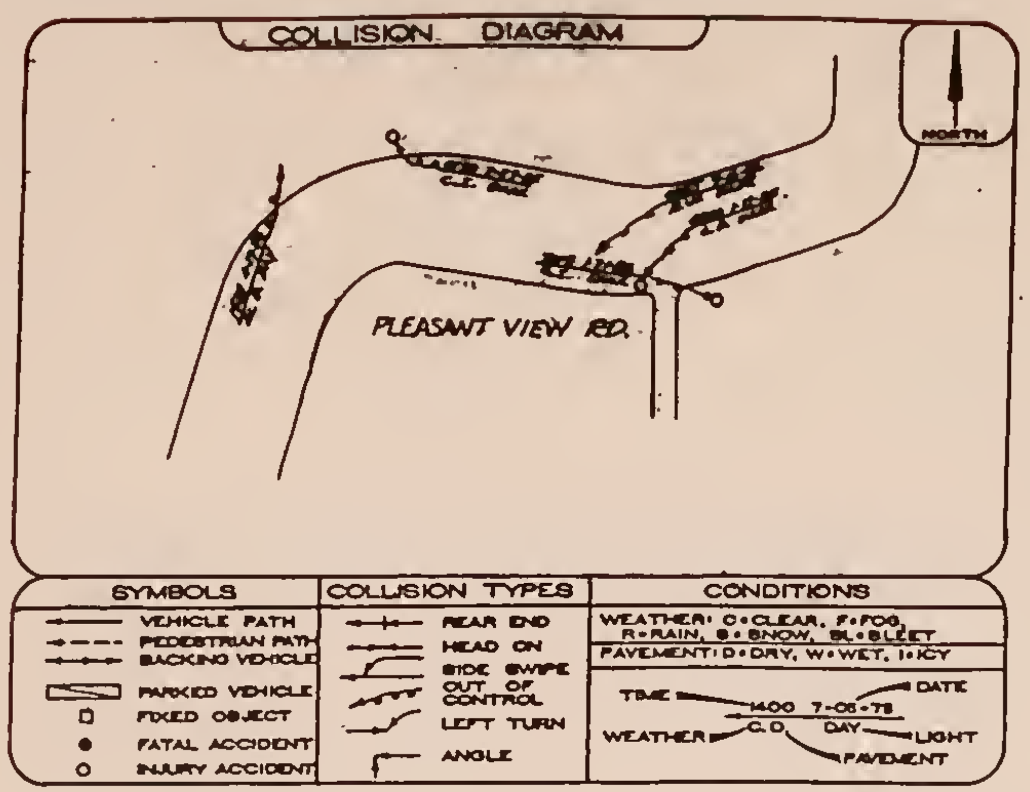
Surveyed By: ______ Designed By: ______ Drawn By: ______ Checked By: ______ Date: ______	Revisions No. ___ Date ______ No. ___ Date ______ No. ___ Date ______ No. ___ Date ______	Project No. Client No.	Sheet No. 1 of ___



ACCIDENT STATISTICS - PLEASANT VIEW ROAD

ACCIDENTS / YEAR :
1985 = 2
1986 = 1
1987 = 0
1988 = 2 TOTAL = 5

ACCIDENT TYPE - % OF TOTAL :
0 HEAD ON = 0%
0 ANGLE = 0%
0 LEFT TURN= 0%
0 SIDE SWP.= 0%
0 REAR END = 0%
5 SINGLE V = 100%
0 OTHER = 0%

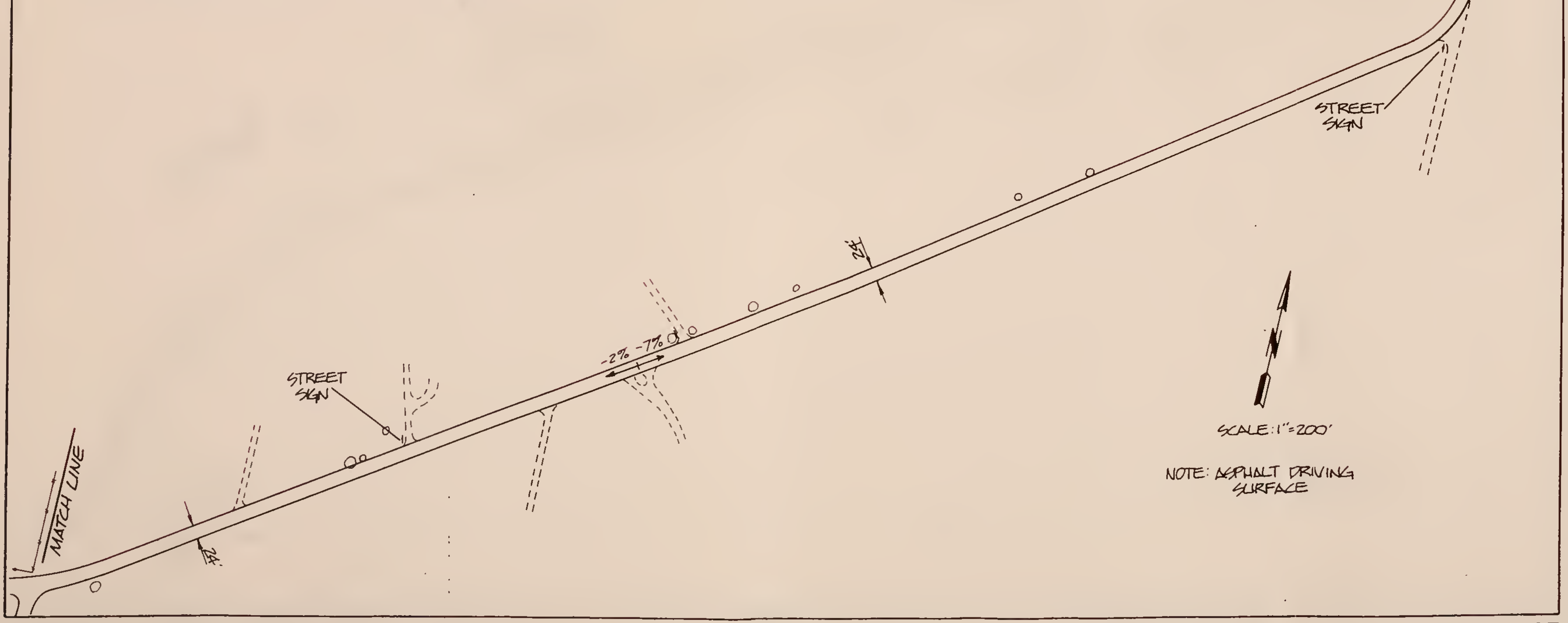
WEATHER CONDITIONS - % OF TOTAL :
4 CLEAR = 80%
1 RAIN = 20%
0 SNOW = 0%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
2 DRY = 40%
1 WET = 20%
2 ICY = 40%

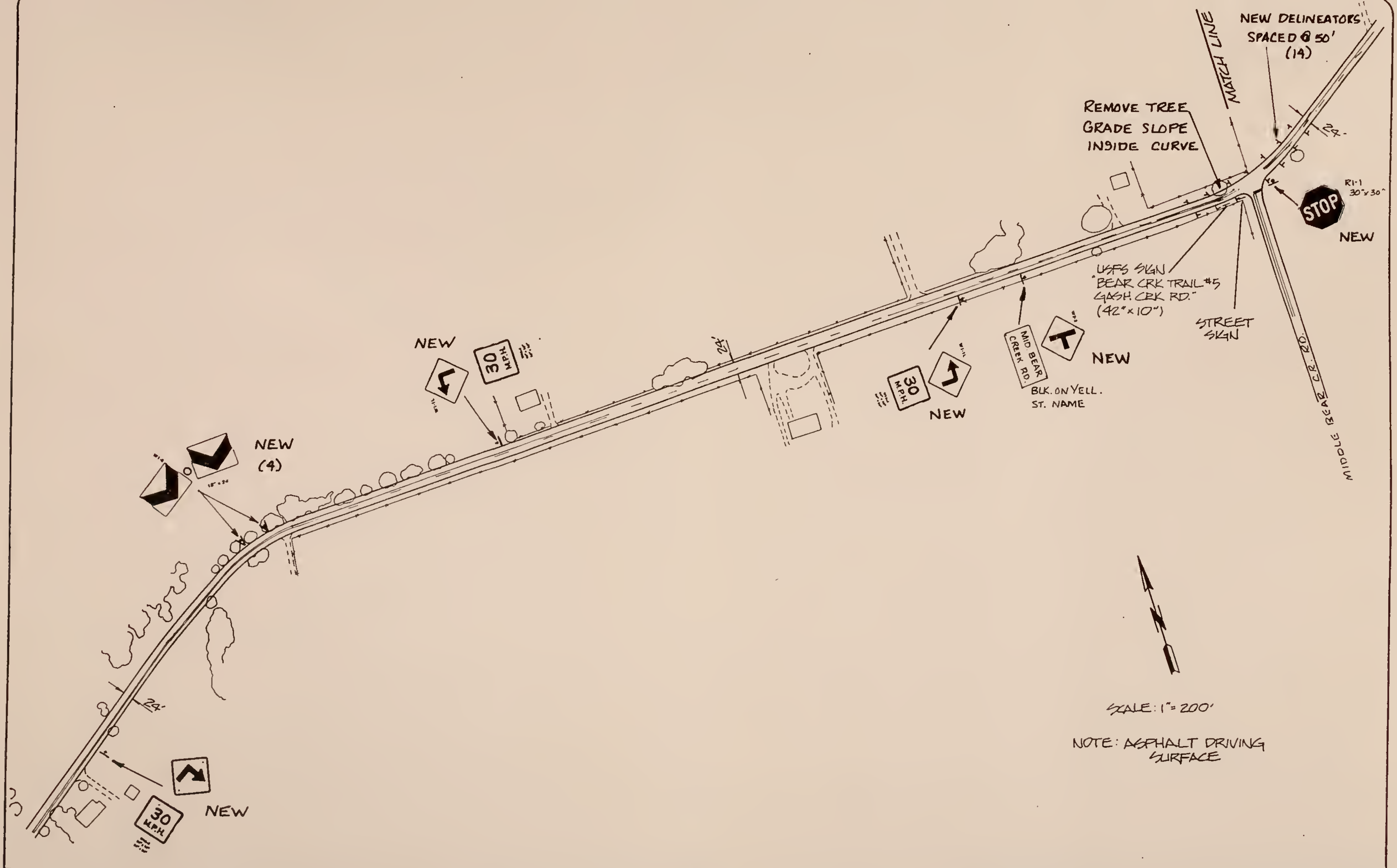
LIGHT CONDITIONS - % OF TOTAL :
4 DARK = 80%
1 DAY = 20%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
3 INJURY = 60%
2 PROP DAM= 40%

ALCOHOL INVOLVED 3
% TOTAL = 60%



MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph. (406) 248-5088	Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title : PLEASANT VIEW ROAD EXISTING CONDITIONS	Surveyed By : Designed By : Drawn By : Checked By : Date :	Revisions No. ___ Date ___ No. ___ Date ___ No. ___ Date ___ No. ___ Date ___	Project No. Client No.	Sheet No. 2 of ___



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Date:

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SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : PLEASANT VIEW ROAD

	# ACC. IN PERIOD		EST. %	CHANGE IN # ACC.	
ACCIDENT TYPE	I/F	PD	CHANGE	I/F	PD
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	0	0%	0.0	0.0
SINGLE VEHICLE	3	2	40%	1.2	0.8
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	3	2	***	1.2	0.8

% REDUCTION IN INJURY/FATAL ACCIDENTS = 40.0%

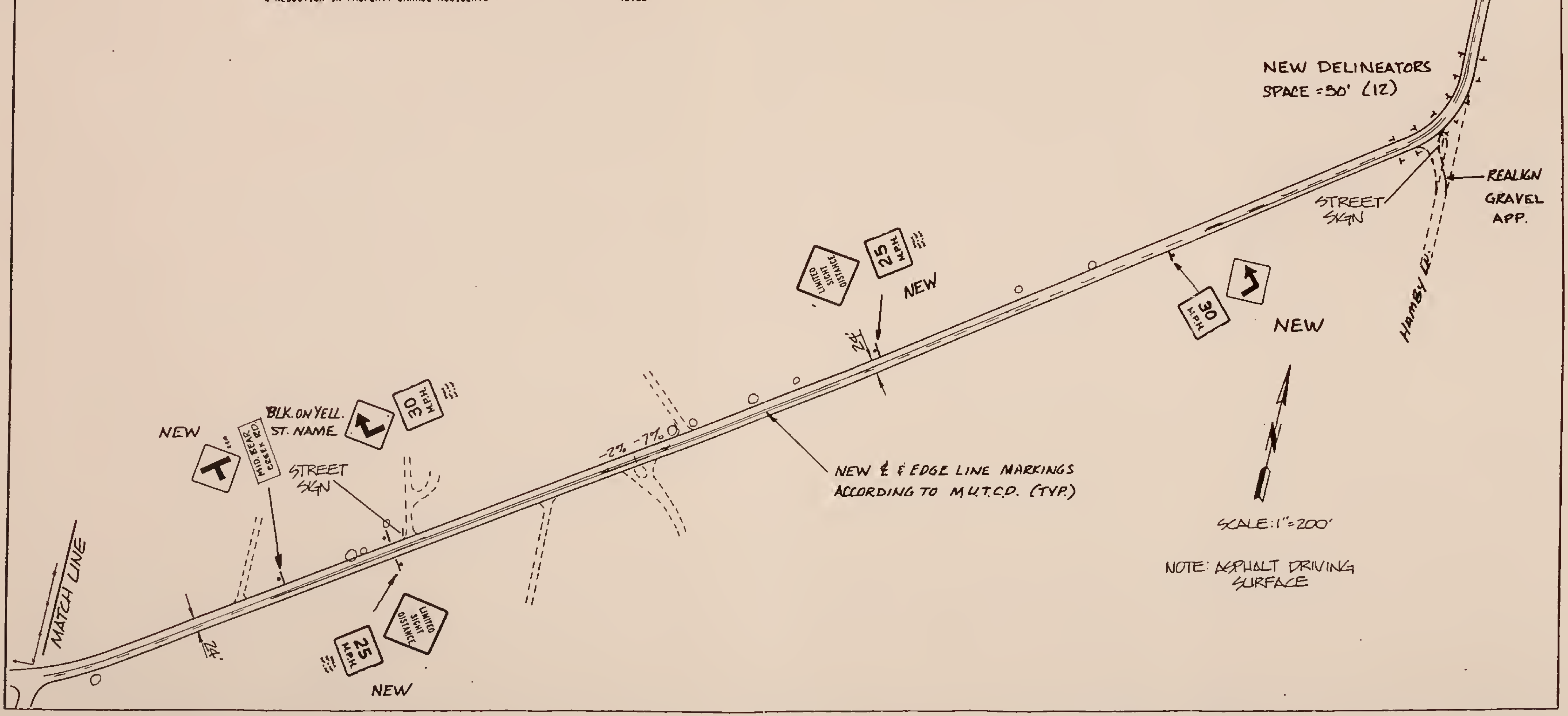
% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 40.0%

P L E A S A N T V I E W R O A D

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (<6 SF)	5	Ea	$100.00	$500.00
2	NEW SIGNS (6.1 TO 10 SF)	10	Ea	$140.00	$1,400.00
1	NEW SUPPLEMENTARY SIGNS	10	Ea	$50.00	$500.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	0	Ea	$20.00	$0.00
4	PAVE. MARKINGS (PAINT)	140	Gal	$30.00	$4,200.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	DELINEATORS, FLEXIBLE	26	Ea	$20.00	$520.00
7	TRIM TREES	0	LS	$320.00	$0.00
8	SLOPE GRADING	1	LS	$1,000.00	$1,000.00

TOTAL CONSTRUCTION COSTS = $8,120.00



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Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-6088

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: PLEASANT VIEW ROAD SHORT TERM IMPROVEMENTS

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SITE

#6

OLD CORVALLIS ROAD
PRIORITY NUMBER 6

SITE DESCRIPTION

Old Corvallis Road is a rural type road which used to be a main road between Hamilton and Corvallis to the north. It begins at a point near the fairgrounds in Hamilton and proceeds along section lines to the north and ends at an intersection with the Woodside Cutoff Road, 1 mile west of Corvallis. It provides access to farms, rural residences and a large biological laboratory near the study site.

The accident cluster area begins at a point approximately 1.6 miles north of Fairgrounds Road in Hamilton and extends 0.6 miles to the north and east. The biological laboratory is located at the northern end of the study site.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located on the three horizontal curves in this section of roadway. The roadway has 24 to 26 foot wide pavement and variable shoulder widths and ditch slopes. There are four horizontal curves in the study section even though two of the curves are back to back and considered to be one "Broken Back" curve. Vertical grades at this site are flat. The roadside environment consists of power poles, grassed embankments, fences, mailboxes and some trees and bushes.

Traffic Control Devices. There are three curve signs existing at this site. Two of the signs are not appropriately placed for the speed of the facility (35mph). One curve only has a curve sign for one direction of travel. No pavement markings are visible in the area.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 1,527 vehicles per day making it the highest traffic volume roadway of all the study sites. Traffic volumes throughout the past four years have probably increased by approximately 4% or more. The County could not provide historical counts at this site. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious potential vehicle operations problems were observed on this section of roadway during the field review. Although, a near miss, pedestrian accident was observed which involved mailboxes on the southern most curve. From the Engineer's perspective during subjective evaluations at the site, it was noted that several additional factors could create potential problems at this site.

1. The curve sections are the only deviations from tangent on the entire route. Adequate attention is not given to this situation.

2. Traffic volumes and types on this road are approaching the character of an urban route. Roadway lane control is becoming critical, especially for passing restrictions and delineation of lanes.

3. Sight distance, geometry of the broken back curve and mailbox locations all contribute to potentially serious accidents at the first curve on the south end of the site.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were six accidents recorded in the four year study period. The accidents seem to be erratic with 2 occurring in 1985 and 3 in 1987. The type of accidents involved primarily single vehicle accidents with one head-on accident on a curve.

The majority of accidents occurred in fair weather conditions and on dry roads. Accidents occurred predominantly during the night time hours. The severity of accidents at this site is split between injury accidents and property damage accidents.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Over-sized curve warning signs are considered necessary in advance of the curves to provide adequate warning of the unexpected conditions. The signs

should be located an adequate distance in advance of the curve as specified by M.U.T.C.D. Proper delineation of the roadway path is especially critical at this site considering the high night time accident rate and relatively high traffic volumes. Pavement markings combined with delineators will provide adequate visual clues as to the proper vehicle path.

Removal of vegetation, widening the curve shoulder and moving mailboxes will reduce the potential for head-on accidents and increase the line of sight around the curve.

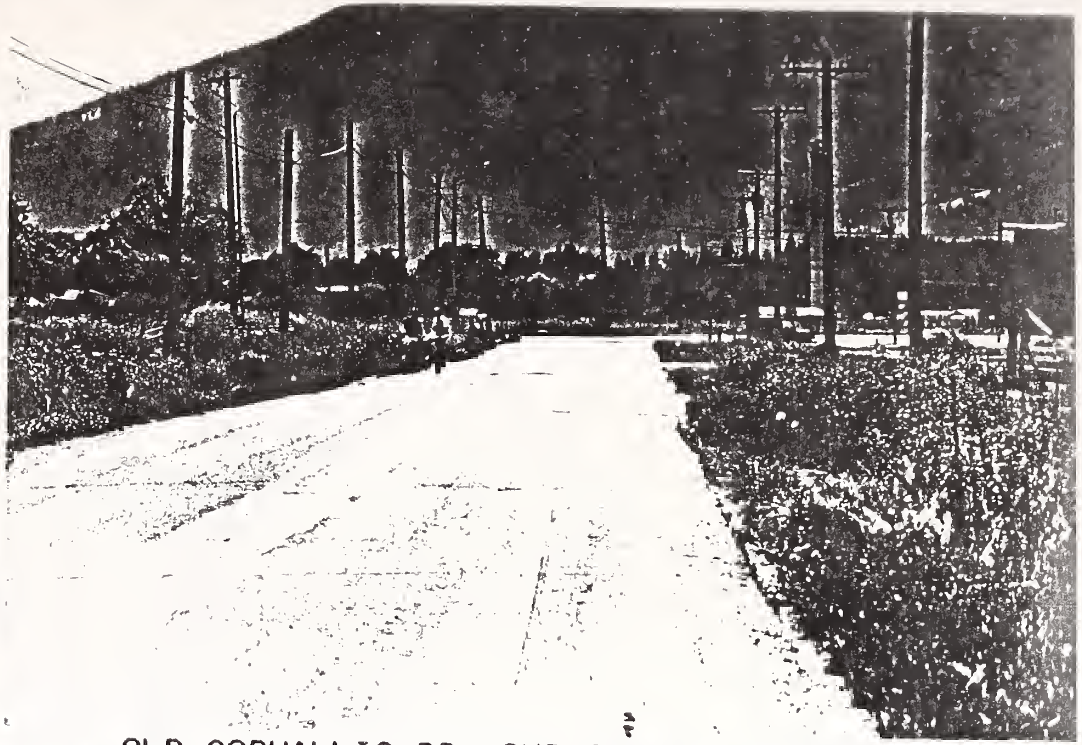
The cost of these improvements is estimated to be aprox-imately $6,480 based on 1989 unit bid contract prices and MDOH fund eligible prices. The grading and pavement markings should be much less if county crews performed the work and the striping were to be completed as part of a county wide pavement marking program.

Long term improvements at this site would involve recon-structing the broken back curve and making it a simple curve with a minimum radii of 800 feet. Very little right-of-way would be required to accomplish this solution. The long term improvement should be considered necessary within the near future.

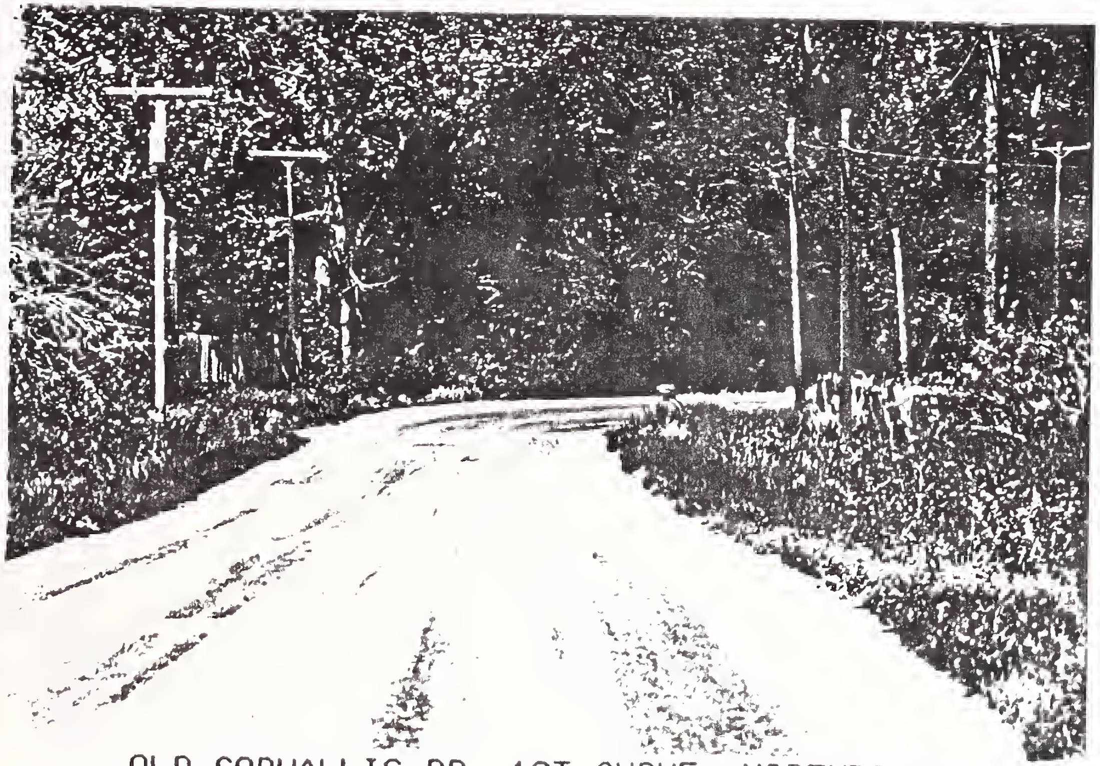
BENEFITS

The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $12,933 annually. The benefit/cost ratio is computed according to accepted methods at 7.53, which makes it a good investment in the economy of Ravalli County.

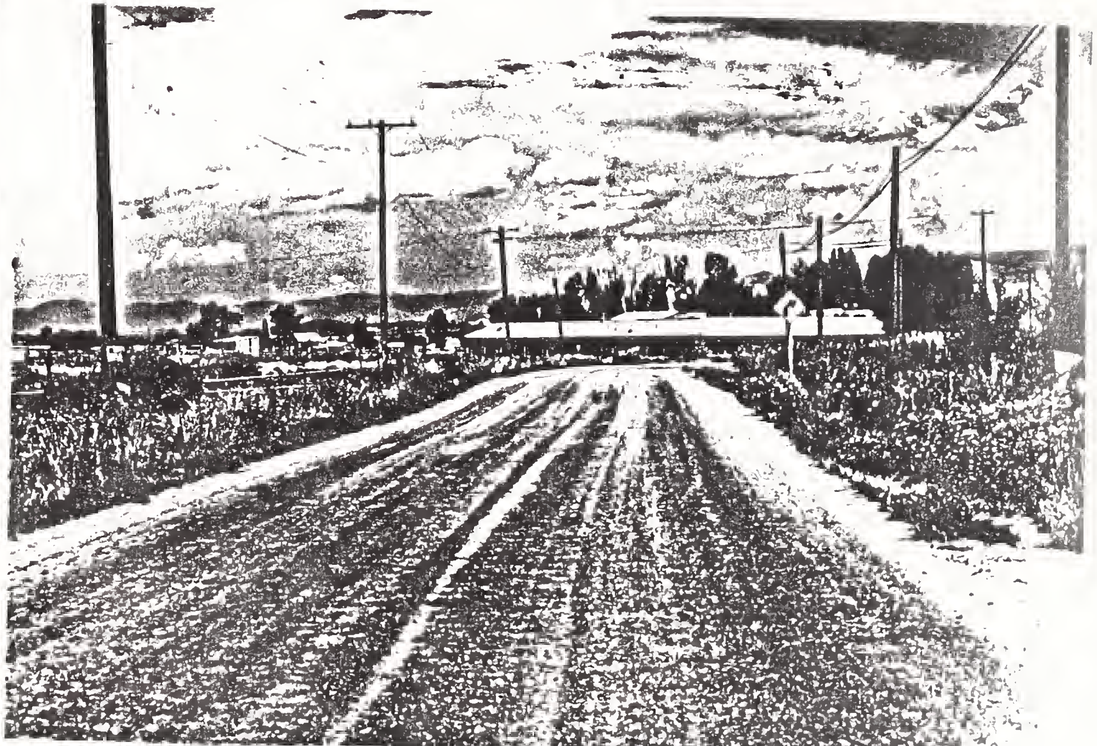
OLD CORVALLIS RD. 1ST CURVE, SOUTHBOUND



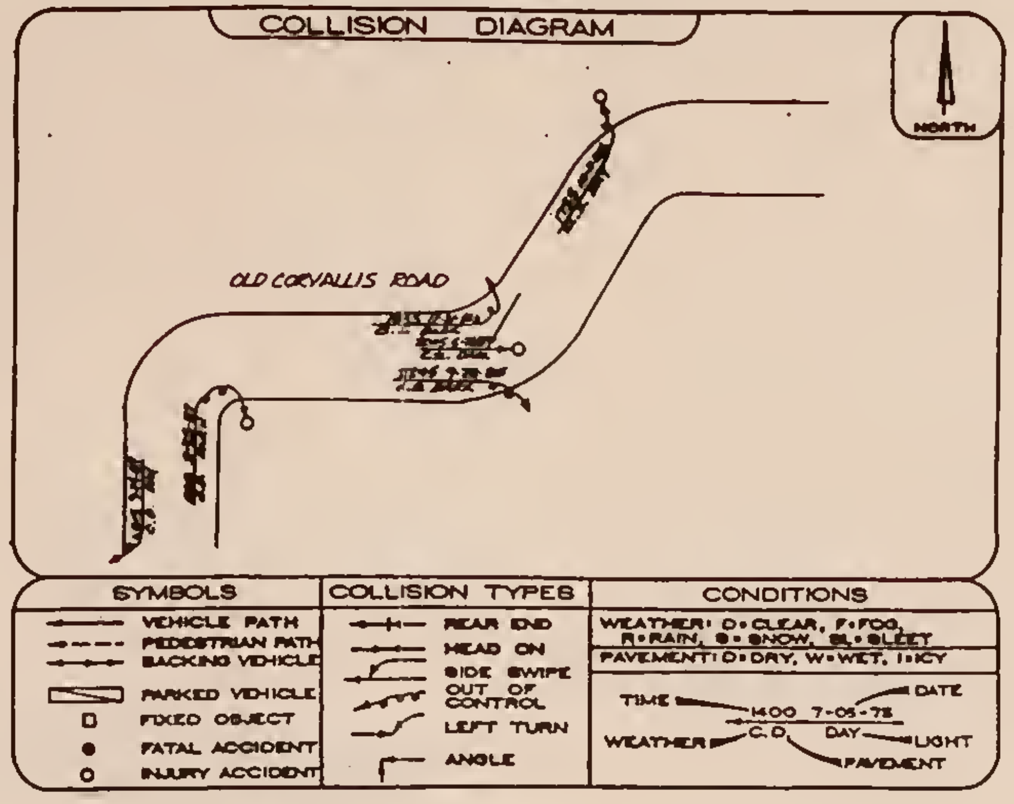
OLD CORVALLIS RD. 2ND CURVE, SOUTHBOUND



OLD CORVALLIS RD. 1ST CURVE, NORTHBOUND



OLD CORVALLIS RD. 3RD CURVE, NORTHBOUND



ACCIDENT STATISTICS - OLD CORVALLIS ROAD

ACCIDENTS / YEAR :
1985 = 2
1986 = 1
1987 = 3
1988 = 0 TOTAL = 6

ACCIDENT TYPE - % OF TOTAL :
1 HEAD ON = 17%
0 ANGLE = 0%
0 LEFT TURN= 0%
0 SIDE SWP.= 0%
0 REAR END = 0%
5 SINGLE V = 83%
0 OTHER = 0%

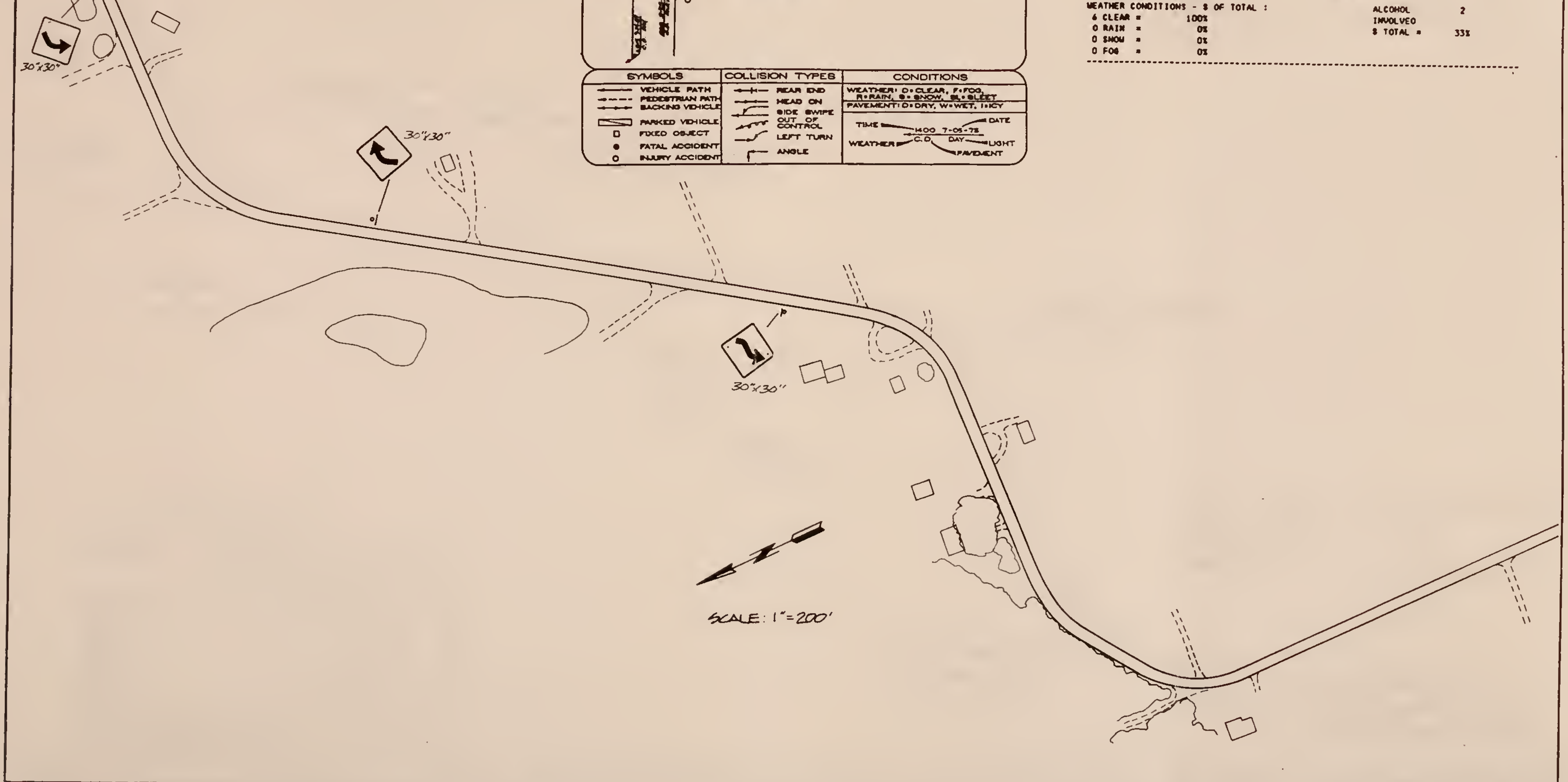
WEATHER CONDITIONS - % OF TOTAL :
6 CLEAR = 100%
0 RAIN = 0%
0 SNOW = 0%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
4 DRY = 67%
0 WET = 0%
2 ICY = 33%

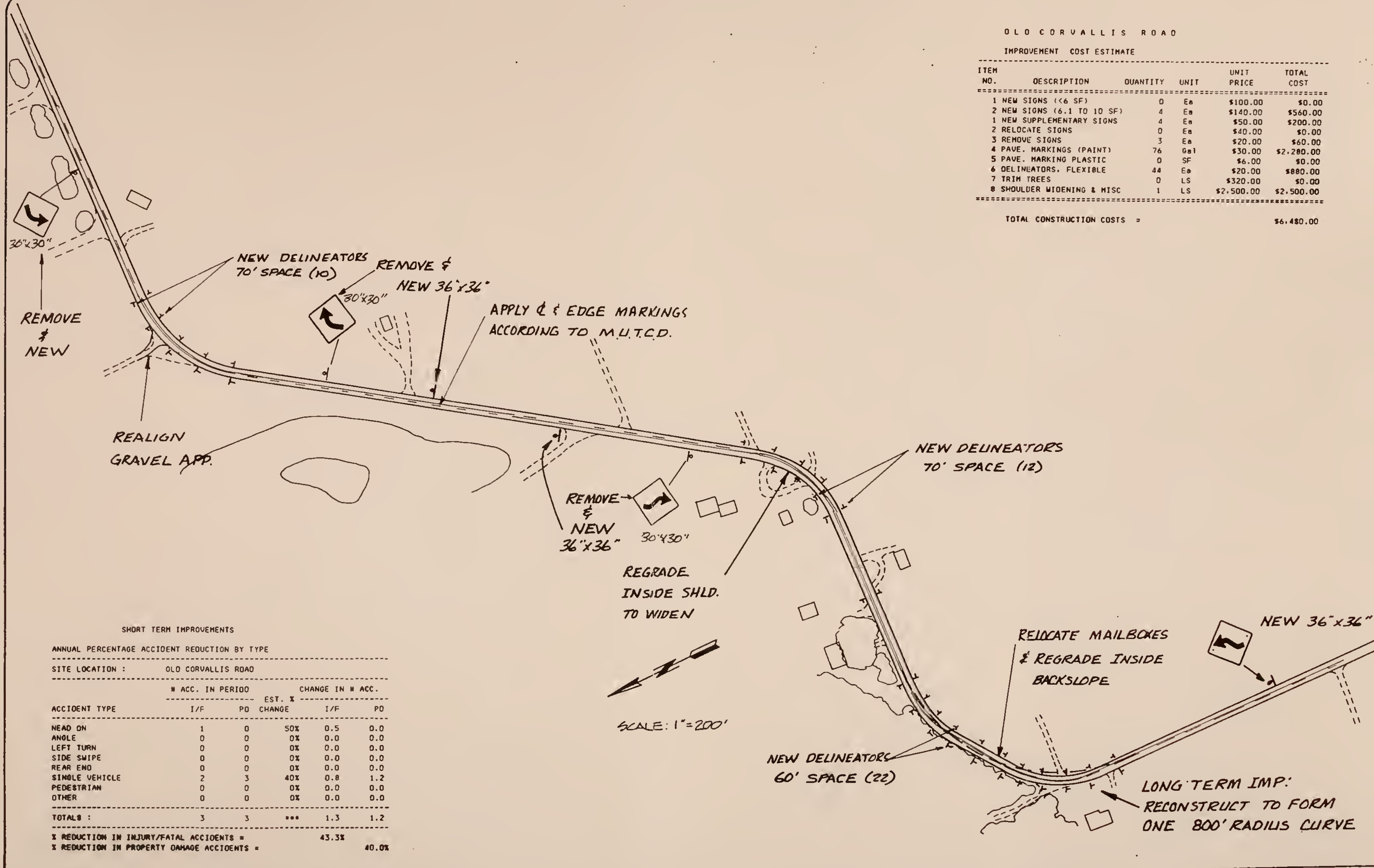
LIGHT CONDITIONS - % OF TOTAL :
4 DARK = 67%
2 DAY = 33%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
3 INJURY = 50%
3 PROP DAM= 50%

ALCOHOL INVOLVED 2
% TOTAL = 33%



MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph (406) 248-5088	Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title : OLD CORVALLIS ROAD EXISTING CONDITIONS	Surveyed By : Designed By : Drawn By : Checked By : Date :	Revisions No. ___ Date ___ No. ___ Date ___ No. ___ Date ___ No. ___ Date ___	Project No Client No.	Sheet No. 1 of ___



O L O C O R V A L L I S R O A D

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (<6 SF)	0	Ea	$100.00	$0.00
2	NEW SIGNS (6.1 TO 10 SF)	4	Ea	$140.00	$560.00
1	NEW SUPPLEMENTARY SIGNS	4	Ea	$50.00	$200.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	3	Ea	$20.00	$60.00
4	PAVE. MARKINGS (PAINT)	76	Gal	$30.00	$2,280.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	OELINEATORS, FLEXIBLE	44	Ea	$20.00	$880.00
7	TRIM TREES	0	LS	$320.00	$0.00
8	SHOULDER WIOENING & MISC	1	LS	$2,500.00	$2,500.00

TOTAL CONSTRUCTION COSTS = $6,480.00

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIOENT REDUCTION BY TYPE

SITE LOCATION : OLO CORVALLIS ROAD

ACCIOENT TYPE	# ACC. IN PERIOO I/F	# ACC. IN PERIOO PO	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PO
NEAD ON	1	0	50%	0.5	0.0
ANOLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR ENO	0	0	0%	0.0	0.0
SINOLE VEHICLE	2	3	40%	0.8	1.2
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	3	3	***	1.3	1.2

% REDUCTION IN INJURY/FATAL ACCIOENTS = 43.3%

% REDUCTION IN PROPERTY OAMAOE ACCIOENTS = 40.0%

MARVIN &ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINOS, MT 59107
Ph. (406) 248-6068

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: OLD CORVALLIS ROAD SHORT TERM IMPROVEMENTS

Surveyed By :
Designed By :
Drawn By :
Checked By :
Date :

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No. ___ Date ___
No. ___ Date ___
No. ___ Date ___
No. ___ Date ___

Project No.

Client No.

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SITE

7

QUAST LANE RXR
PRIORITY NUMBER 7

SITE DESCRIPTION

Quast lane is a is a rural east-west road located one mile north of Corvallis. It begins at an intersection with the Eastside Highway and ends 2.5 miles east at an intersection with Summerdale Road. It provides access to farms, rural residences and acts as a cross connection between north-south routes.

The accident cluster area is confined to the railroad crossing area approximately 0.4 miles east of the Eastside Highway.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. The roadway has 21 foot wide pavement surface and has no discernable shoulders or ditch sections. Fences and power poles are within 5 feet of the pavement edge. The crossing approach grades are nearly flat. A 9-10% grade exists approximately 400 feet east of the crossing. The pavement surface is extremely rough and has a washboard texture. Private drive approaches are within the crossing site. Metal buildings in the southeast quadrant of the crossing and haystacks in the northwest quadrant of the crossing block approach sight distance to the tracks.

Traffic Control Devices. There are advanced crossing signs and under-sized x-bucks existing at this site along with weight limit signs. There are the remnants of RXR pavement markings well in advance of the crossing, but no other pavement markings exist.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 290 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4%. The County could not provide historical counts at this site. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious potential vehicle operations problems were observed on this section of roadway during the field review since the traffic volumes were so low. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors could create potential problems at this site.

1. The roadside environment is so confining that it feels as if you are driving through a tunnel. There is absolutely no room for driver error or avoidance maneuvers.

2. The pavement condition is so bad that vehicle control would be minimal at higher speeds.

3. Sight distance to the tracks is restricted in two quadrants of the intersection. The haystacks limit sight distance to no more than 150 feet while the buildings limit it to approximately 250 feet.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were two accidents recorded in the four year study period. One accident occurred in 1985 and one in 1988. One of the accidents was collision with a train and the other was a rearend accident.

The accidents occurred in fair weather conditions and on dry roads. Accidents occurred during daylight hours. The severity of accidents at this site is split between injury accidents and property damage accidents.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of some of the above noted problems. The sight distance restrictions should be removed as best as practical. The haystacks could be relocated if agreements are made with the landowner. The metal buildings are railroad building which may not be as easy to relocate, but some agreement may be negotiated with the railroad company.

It would be desirable to overlay the existing pavement in this area if maintenance funds were available. If this possibility exists in the near future, it should be completed

prior to installing new RXR pavement markings as shown in the sketch. Standard size cross bucks should replace the existing ones and located in the most visible location. The railroad retains the right to install these signs, and installation should be coordinated with them. A weight limit sign is currently blocking the view of an advanced RXR warning sign and should be relocated.

Warrants adopted by the Montana Department of Highways for RXR protection were obtained, and an analysis at this site was completed. The following is a summary of the factors and analysis:

H.I. = AAHT x AATT x (F1+F2+...F10) / 100

F1 (Train Move.)	= 2.0
F2 (Tracks)	= 0.1
F3 (Sight Dist)	= 2.0
F4 (Angle)	= 0.0
F5 (Hwy Align)	= 0.1
F6 (# lanes)	= 0.1
F7 (Grade)	= 0.0
F8 (Vert Sight)	= 0.0
F9 (Width)	= 0.2
F10 (Local Inter)	= 0.1
F tot(1..10)	= 4.6

H.I. = 300 x 4 x (4.6) / 100 = 55.2

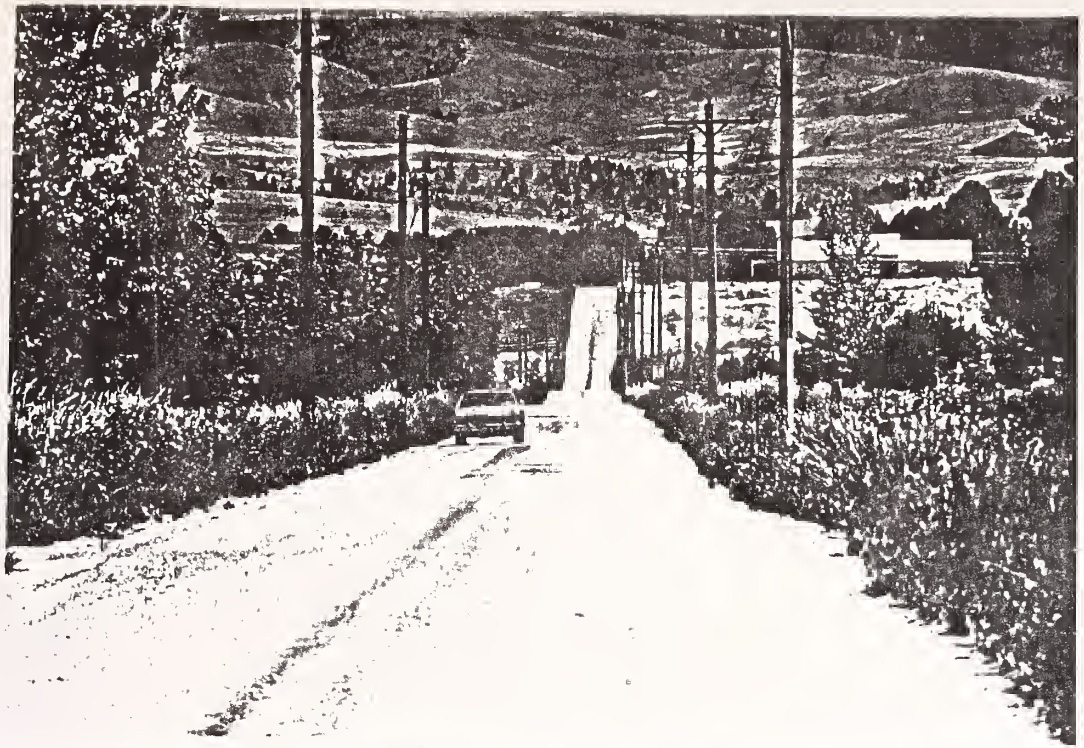
The warrants for flashing light protection is an H.I. greater than 200. Therefore, the cross bucks are considered to be adequate protection at this crossing. MDOH had indicated that their records show a hazard index of 4.0 at this location, much less than what this calculation indicates.

The cost of these improvements is estimated to be approximately $3,996 based on 1989 unit bid contract prices and MDOH fund eligible prices. The pavement markings should be much less if county crews performed the work or the striping were to be completed as part of a county wide pavement marking program.

Long term improvements at this site could not be estimated because of the limited function of the roadway and the major degree of work that would be required in reconstructing the roadway.

BENEFITS

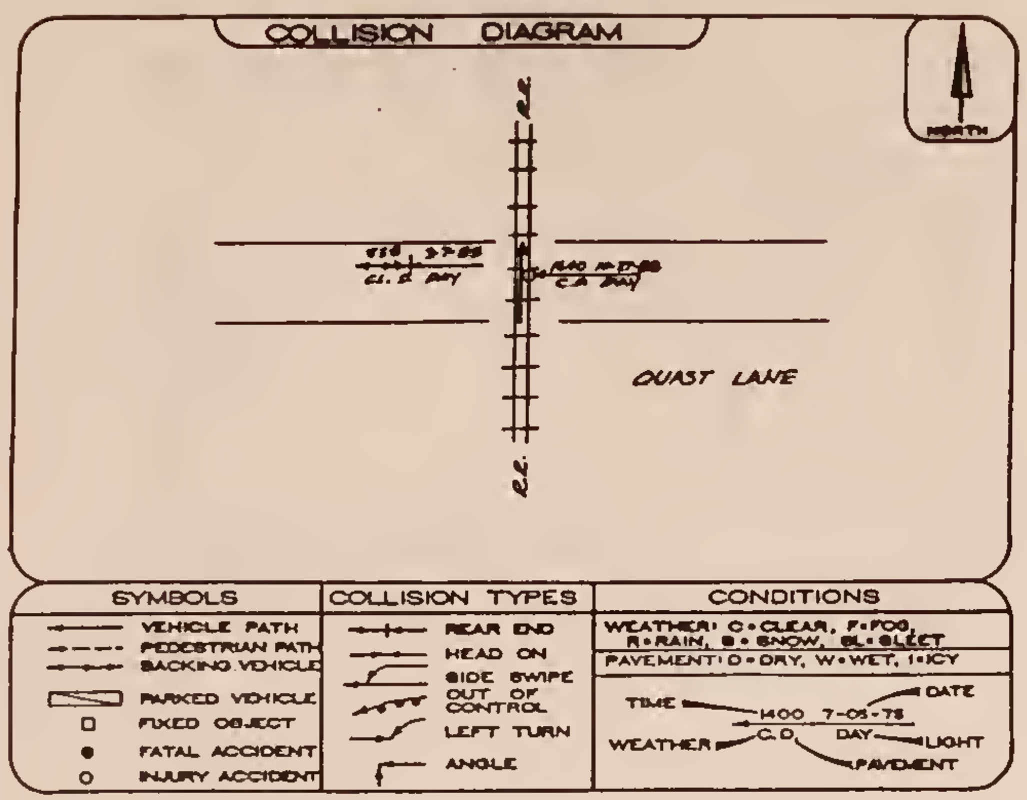
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $3,016 annually. The benefit/cost ratio is computed according to accepted methods at 2.73, which still makes it a good investment .


QUAST LANE RXR, EASTBOUND


QUAST LANE RXR, WESTBOUND


QUAST LANE RXR TRACKS LOOKING NORTH


QUAST LANE RXR TRACKS, LOOKING SOUTH



ACCIDENT STATISTICS - QUAST LANE

ACCIDENTS / YEAR :
1985 = 1
1986 = 0
1987 = 0
1988 = 1 TOTAL = 2

ACCIDENT TYPE - % OF TOTAL :
0 HEAD ON = 0%
0 ANGLE = 0%
0 LEFT TURN= 0%
0 SIDE SWP.= 0%
0 REAR END = 0%
0 SINGLE V = 0%
2 OTHER = 100%

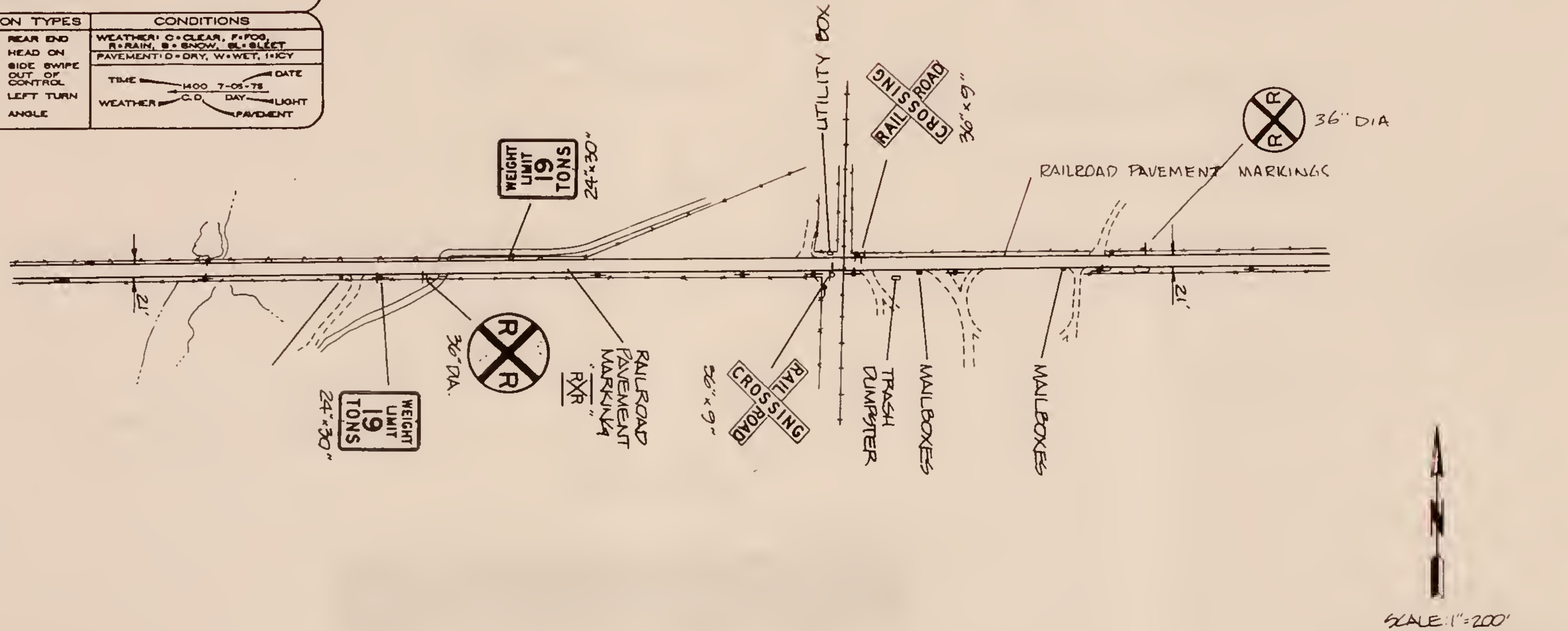
WEATHER CONDITIONS - % OF TOTAL :
2 CLEAR = 100%
0 RAIN = 0%
0 SNOW = 0%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
2 DRY = 100%
0 WET = 0%
0 ICY = 0%

LIGHT CONDITIONS - % OF TOTAL :
0 DARK = 0%
2 DAY = 100%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
1 INJURY = 50%
1 PROP DAM= 50%

ALCOHOL INVOLVED 0
% TOTAL = 0%



NOTE: ASPHALT DRIVING SURFACE

MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph (406) 248-6088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: QUAST LANE RXR EXISTING CONDITIONS	Surveyed By: Designed By: Drawn By: Checked By: Date	Revisions No. Date No. Date No. Date No. Date	Project No Client No.	Sheet No. 1 of

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : QUAST LANE RXR

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	1	30%	0.0	0.3
SINGLE VEHICLE	0	0	0%	0.0	0.0
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	1	0	30%	0.3	0.0
TOTALS :	1	1	***	0.3	0.3

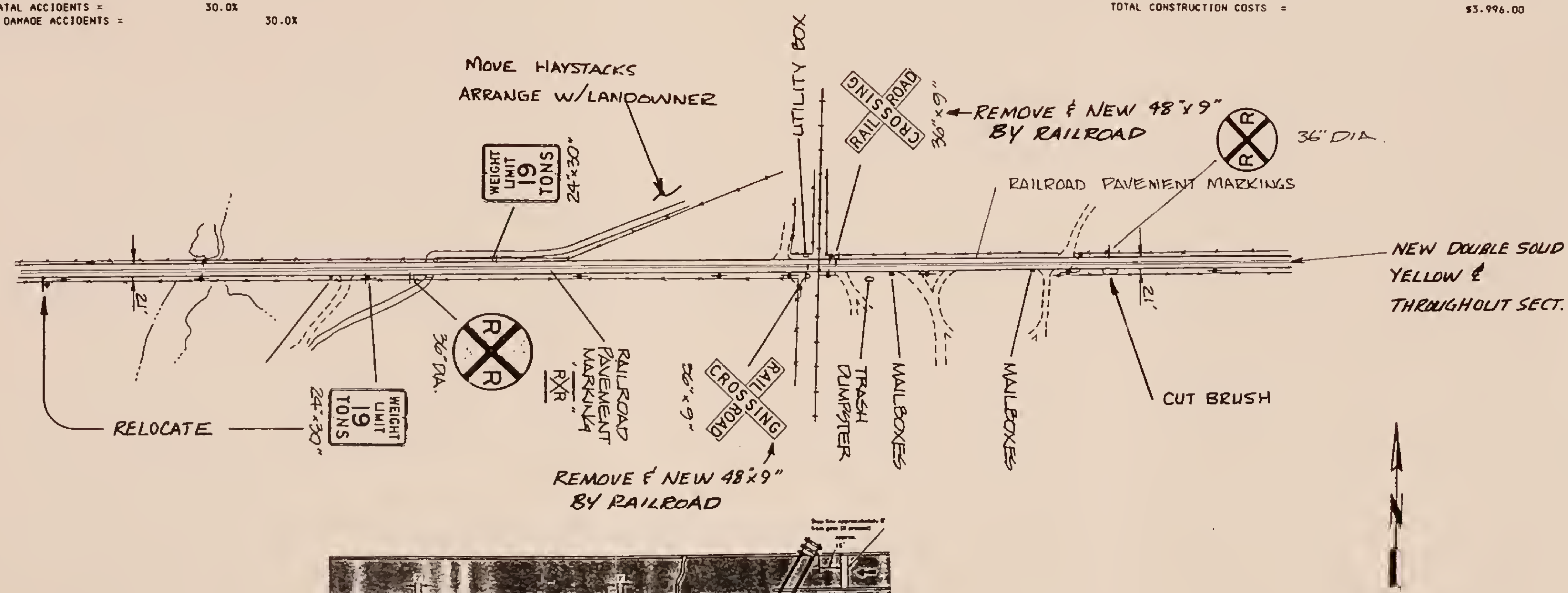
% REDUCTION IN INJURY/FATAL ACCIDENTS = 30.0%
% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 30.0%

Q U A S T L A N E R X R

IMPROVEMENT COST ESTIMATE

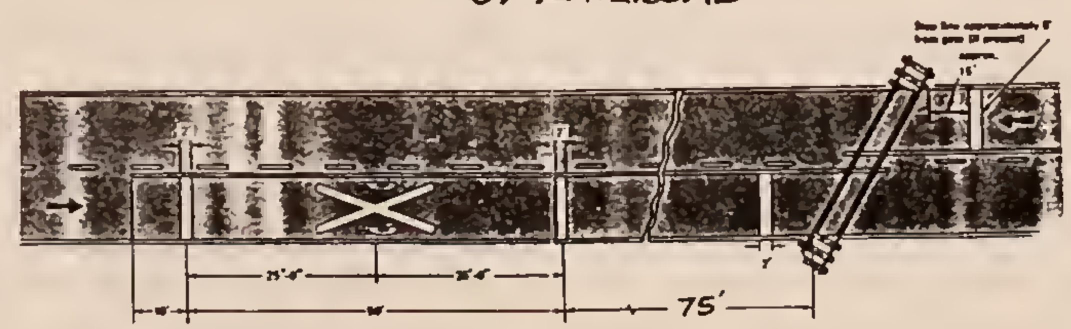
ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (< 6SF)	2	Ea	$100.00	$200.00
2	NEW SIGNS (6.1 TO 10 SF)	0	Ea	$140.00	$0.00
1	NEW SUPPLEMENTARY SIGNS	0	Ea	$50.00	$0.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	0	Ea	$20.00	$0.00
4	PAVE. MARKINGS (PAINT)	40	Gal	$30.00	$1,200.00
5	PAVE. MARKING PLASTIC	296	SF	$6.00	$1,776.00
6	DELINEATORS, FLEXIBLE	0	Ea	$20.00	$0.00
7	TRIM TREES	1	LS	$320.00	$320.00
8	MISCELLANEOUS WORK	1	LS	$500.00	$500.00

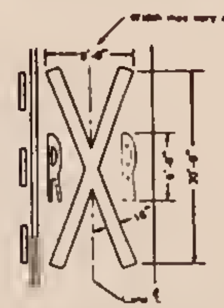
TOTAL CONSTRUCTION COSTS = $3,996.00



SCALE: 1"=200'

NOTE: ASPHALT DRIVING SURFACE





NEW RXR PAVEMENT MARKINGS BOTH APP.

SITE #8

WILLOW CREEK ROAD RXR
PRIORITY NUMBER 8

SITE DESCRIPTION

Willow Creek Road is a rural type east-west road which passes through Corvallis and is one of Corvallis' main streets. It is also designated as FAS 373 on the state Secondary road system. It begins approximately 2.5 miles west of Highway 93 and extends through Corvallis to a point approximately 3.5 miles east of Highway 93. It is a major east-west route which connects all north-south routes in the valley and provides access to farms and residences along its course.

The accident cluster area is confined to the railroad crossing area approximately 0.4 miles east of the Eastside Highway through Corvallis.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. The roadway has 22 foot wide pavement surface and variable width shoulders and ditch sections. A reverse curve precedes the RXR in the eastbound direction. Numerous drive approaches are located in this area and there is a good deal of roadside vegetation. Vertical grades are fairly flat within the site. However, there are slight sag and crest vertical curves in the crossing area. The pavement surface is bad shape at intermittent points within the site area.

The railroad tracks are in the middle of a curve at the crossing site. The crossing angle is at 59 degrees. A high embankment along the tracks on the north side of the road severely limits vehicle-train sight distance. Trees, combined with the physical geometry of the roadway, also limits sight distance for westbound traffic. Private drive approaches are within the crossing site.

Traffic Control Devices. There are advanced crossing signing and x-bucks existing at this site along with hazard markers on bridges, speed limit signs and a curve sign. There are no pavement markings existing at this site.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 970 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4% or more. The County could not provide historical counts at this site. However, the Department of Highways was able to provide several years of traffic counts. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious conflicts in vehicle operations were observed on this section of roadway during the field review. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors could

create potential problems at this site.

1. The reverse curve preceding the crossing is difficult to traverse without overlapping on the opposing lane. this situation tends to absorb most drivers full attention and any other roadway information is lost while in the curve.

2. There is a momentary loss of stopping sight distance in the westbound direction because of a sag vertical curve east of the crossing.

3. Sight distance for eastbound traffic to the north at the crossing is extremely limited which is not noticeable until the vehicle is almost on the tracks.

4. The speed limit seems to be inappropriate for the type of road and roadside environment. With this speed limit it is difficult to properly sign the reverse curve.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were three accidents recorded in the four year study period. One accident occurred in 1985 and one each in 1987 and 1988. One of the accidents was collision with a train, one was a head-on and the other was a rearend accident.

The accidents occurred in fair weather conditions and on dry roads. Accidents occurred during daylight hours. The severity of accidents at this site is quite high with all of them producing injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of some of the above noted problems. The sight distance restrictions should be removed as best as practical. Trees could be removed if agreements are made with the landowner. The railroad cut slope could be daylighted if agreements with the railroad and adjacent landowners could be reached. However, flashing railroad signal lights would be an acceptable alternative to physical reconstruction of the railroad embankments.

It would be desirable to overlay the existing pavement in this area if maintenance funds were available. If this possibility exists in the near future, it should be completed prior to installing new RXR pavement markings as shown in the sketch. Additional curve signing should be installed which indicates the advisory speed even though it is the same as the speed limit. It is recommended that a speed limit study be completed in this area to determine the correct speed limit boundaries.

Warrants adopted by the Montana Department of Highways for RXR protection were obtained and an analysis at this site was completed. The following is a summary of the factors and analysis:

H.I. = AAHT x AATT x (F1+F2+...F10) / 100

F1 (Train Move.)	= 2.0
F2 (Tracks)	= 0.1
F3 (Sight Dist)	= 2.0
F4 (Angle)	= 0.8
F5 (Hwy Align)	= 0.1
F6 (# lanes)	= 0.1
F7 (Grade)	= 0.0
F8 (Vert Sight)	= 0.1
F9 (Width)	= 0.2
F10 (Local Inter)	= 0.1
F tot	= 5.5

H.I. = 1000 x 4 x (5.5) / 100 = 220

The warrants for flashing light protection is an H.I. greater than 200. Therefore, flashing light signals combined with the cross bucks are considered to be warranted protection at this crossing. MDOH had indicated that their records show a hazard index of 30.0 at this location, much less than what this calculation indicates. Either their calculations haven't been updated or some of their information was in error. MDOH should be

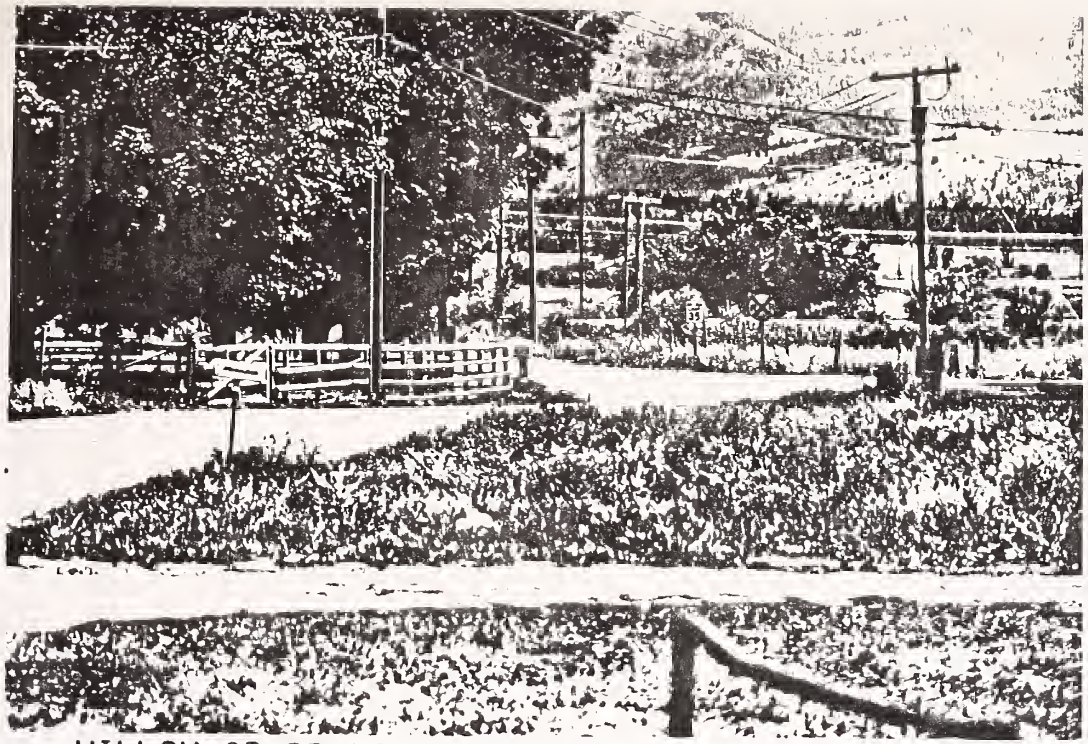
assessed of this situation and funds requested to install the flashing control under the FHWA crossing protection program. For purposes of this study, the cost of reconstructing the railroad embankment only was included in the cost analysis. If signals are installed, reconstruction of the railroad embankment would not be necessary.

The cost of these improvements is estimated to be approximately $12,046 based on 1989 unit bid contract prices and MDOH fund eligible prices. The pavement markings should be much less if county crews performed the work or the striping were to be completed as part of a county wide pavement marking program. The cost of regarding the railroad embankment may vary considerably depending on future agreements. Costs for the alternative flashing signals would probably be in excess of $ 20,000.

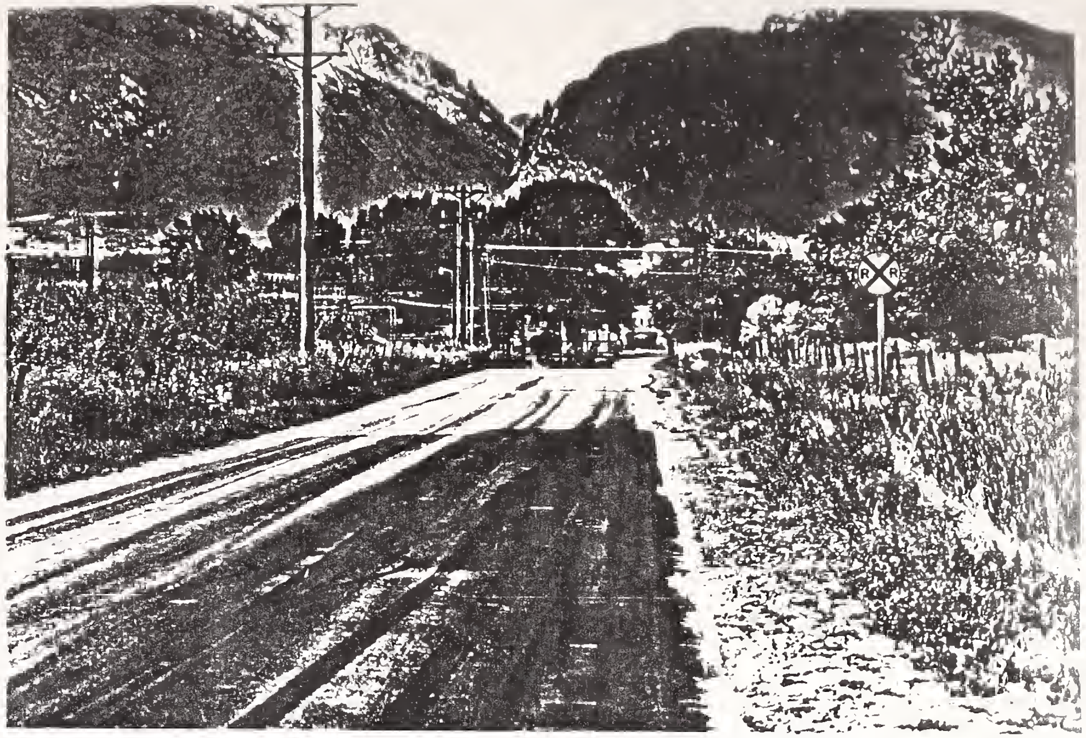
Long term improvements at this site should consider upgrading the entire roadway to urban type standards when future growth occurs.

BENEFITS

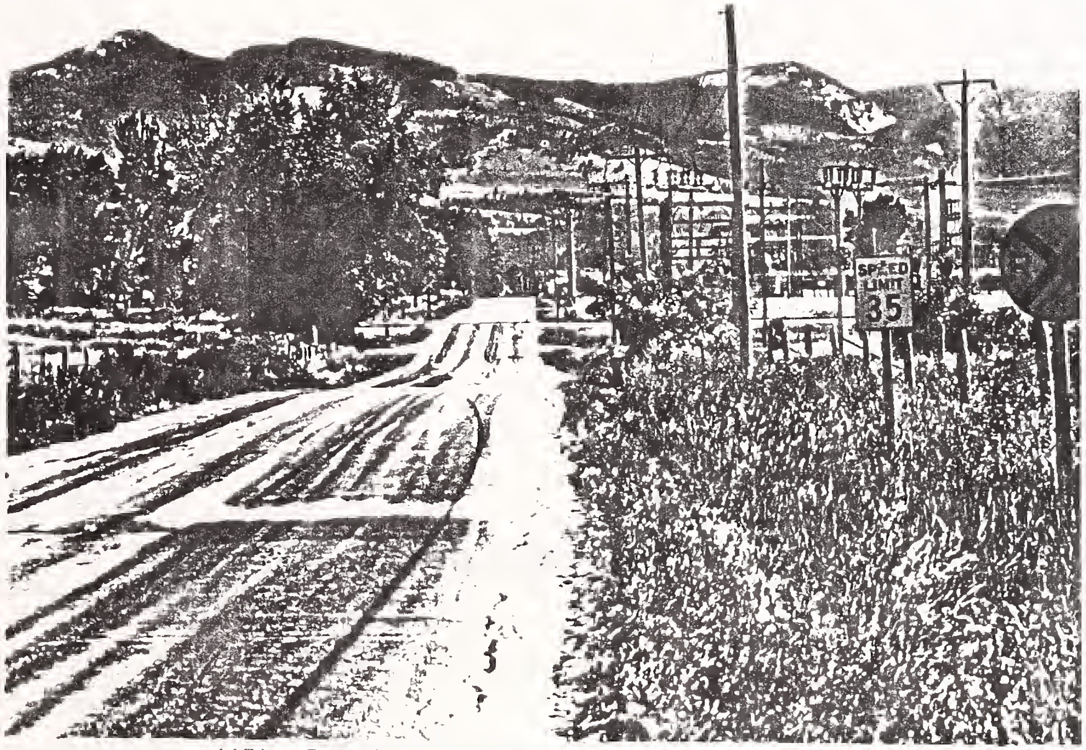
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $9,566 annually. The benefit/cost ratio is computed according to accepted methods at 2.96, which still makes it a good investment .



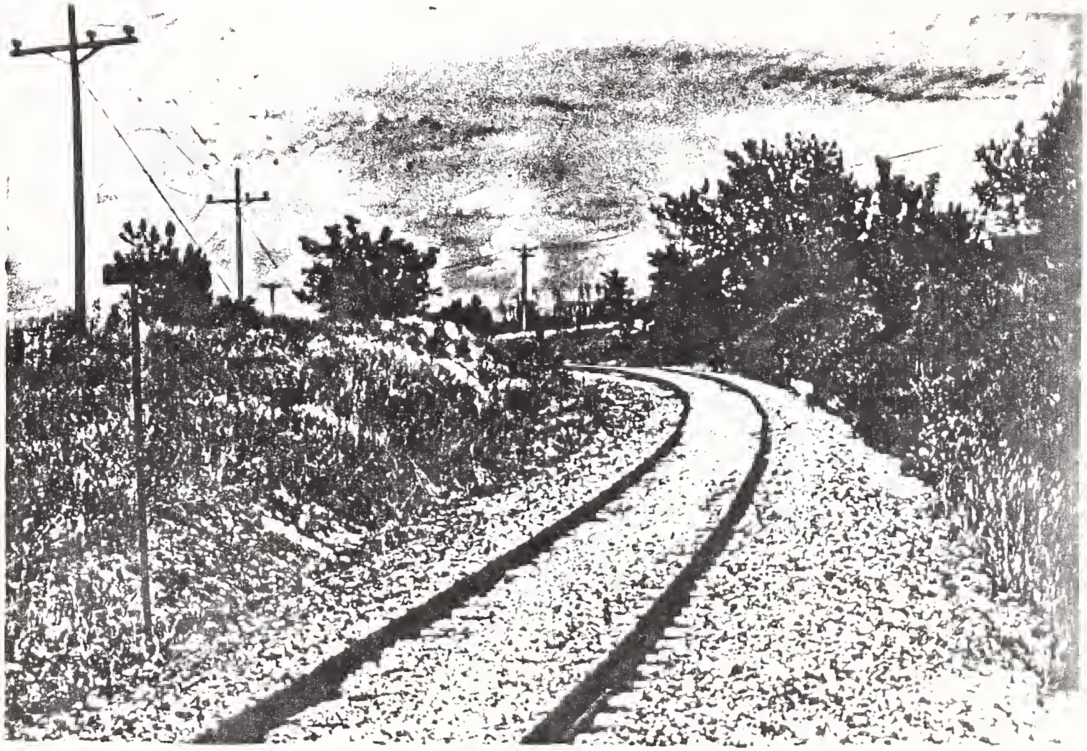
WILLOW CR RD "S" CURVE APP TO RXR, EASTBOUND



WILLOW CR RD RXR, SOUTHBOUND



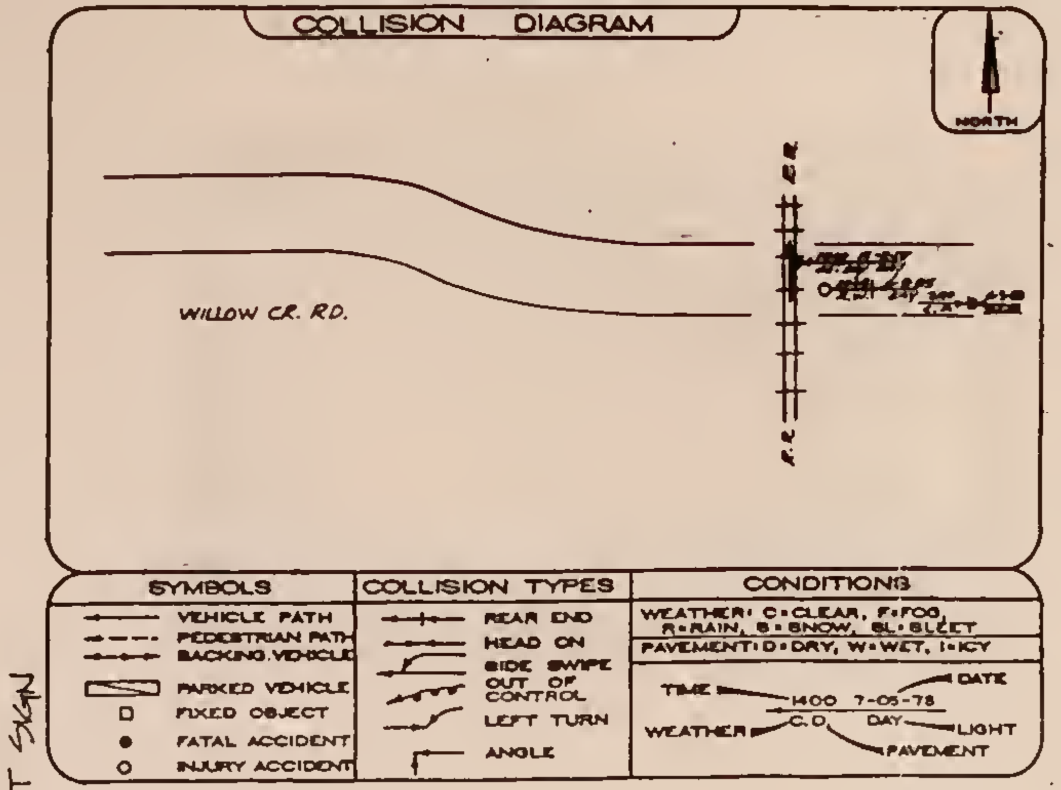
WILLOW CR RD RXR, EASTBOUND

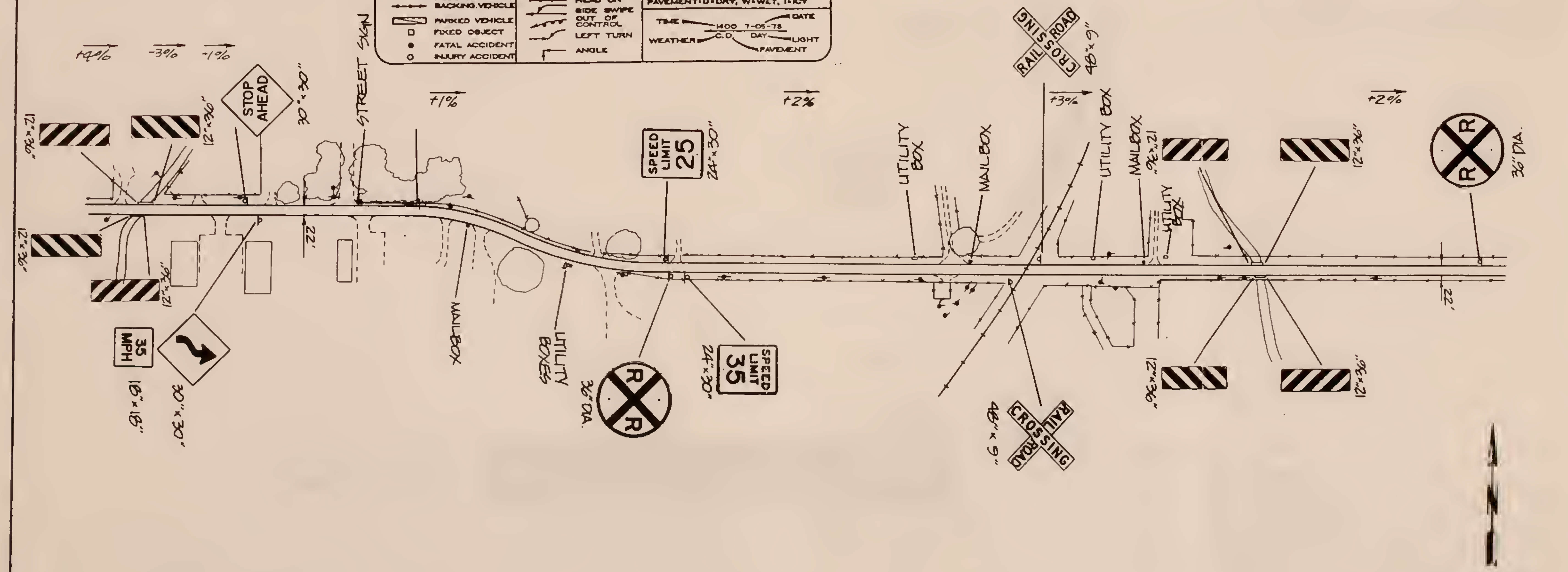


WILLOW CR RD TRACKS, LOOKING NORTH

ACCIDENT STATISTICS - WILOW CREEK ROAD

```
ACCIDENTS / YEAR :                       ROAD CONDITIONS - % OF TOTAL :
   1985 =  1                          2 DRY  =        67%
   1986 =  0                          1 WET  =        33%
   1987 =  1                          0 ICY  =         0%
   1988 =  1 TOTAL =   3                LIGHT CONDITIONS - % OF TOTAL :
ACCIDENT TYPE - % OF TOTAL :          1 DARK =        33%
 1 HEAD ON  =      33%                2 DAY  =        67%
 0 ANGLE    =       0%
 0 LEFT TURN=       0%                  SEVERITY - % OF TOTAL :
 0 SIDE SWP.=       0%                0 FATAL    =     0%
 1 REAR END =      33%                3 INJURY   =   100%
 0 SINGLE V =       0%                0 PROP DAM=      0%
 1 OTHER    =      33%
WEATHER CONDITIONS - % OF TOTAL :              ALCOHOL        0
 2 CLEAR =         67%                         INVOLVED
 1 RAIN  =         33%                         % TOTAL =      0%
 0 SNOW  =          0%
 0 FOG   =          0%
```





SCALE: 1"=200'

NOTE: ASPHALT DRIVING SURFACE

NO MARKINGS ON ASPHALT

MARVIN & ASSOCIATES, SUITE 304 TRANSWESTERN I, 404 N. 31st, BILLINGS, MT 59107, Ph. (406) 248-5088. Traffic Transportation & Civil Engineers	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: WILLOW CREEK ROAD RXR EXISTING CONDITIONS	Surveyed By: / Designed By: / Drawn By: / Checked By: / Date	Revisions: No. Date / No. Date / No. Date / No. Date	Project No. / Client No.	Sheet No. 1 of

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : WILLOW CREEK ROAD RXR

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	1	0	40%	0.4	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	1	0	30%	0.3	0.0
SINGLE VEHICLE	0	0	0%	0.0	0.0
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	1	0	30%	0.3	0.0
TOTALS :	3	0	***	1.0	0.0

% REDUCTION IN INJURY/FATAL ACCIDENTS = 33.3%

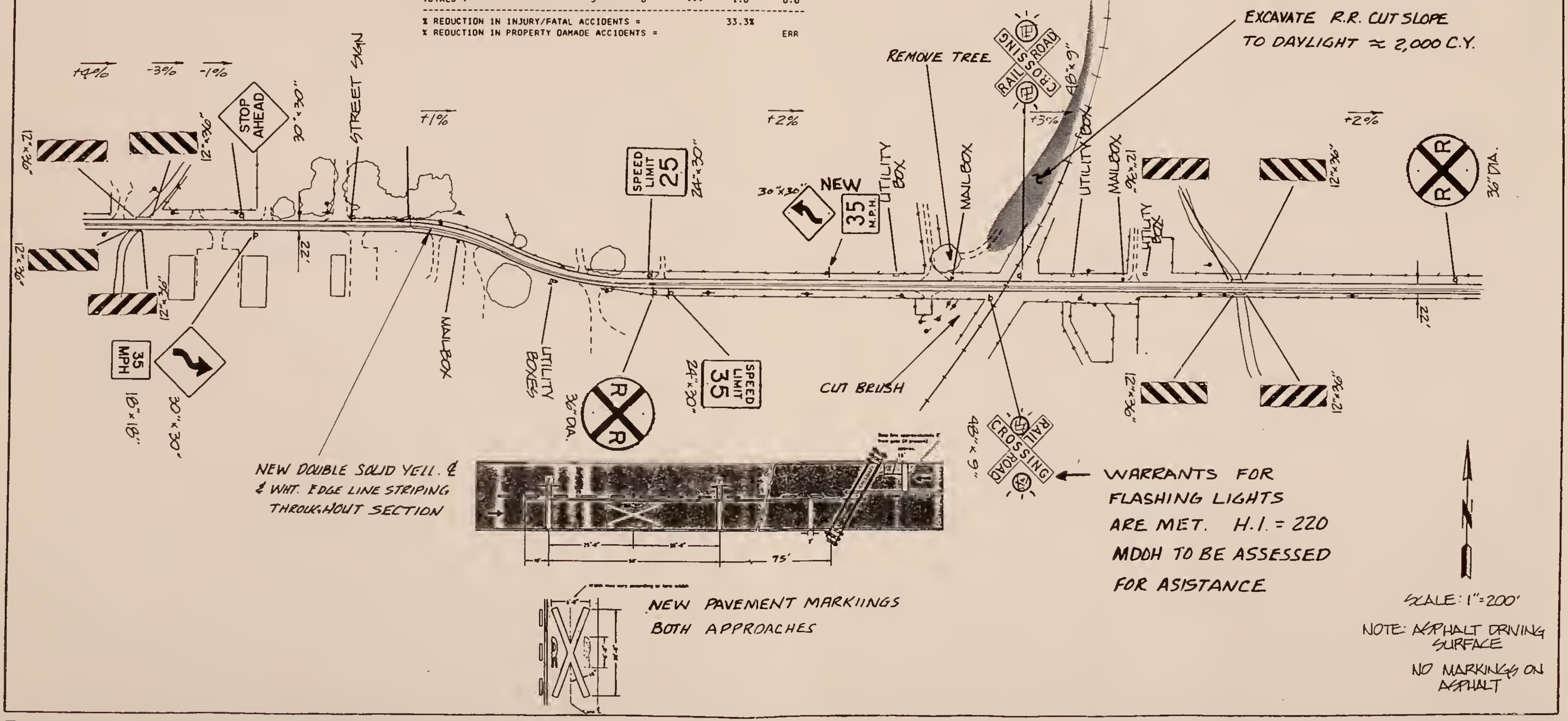
% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = ERR

WILLOW CREEK ROAD RXR

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (< 6SF)	1	Ea	$100.00	$100.00
2	NEW SIGNS (6.1 TO 10 SF)	0	Ea	$140.00	$0.00
1	NEW SUPPLEMENTARY SIGNS	1	Ea	$50.00	$50.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	0	Ea	$20.00	$0.00
4	PAVE. MARKINGS (PAINT)	60	Gal	$30.00	$1,800.00
5	PAVE. MARKING PLASTIC	296	SF	$6.00	$1,776.00
6	DELINEATORS, FLEXIBLE	0	Ea	$20.00	$0.00
7	TRIM TREES	1	LS	$320.00	$320.00
8	SLOPE EXCAVATION	2000	CY	$4.00	$8,000.00

TOTAL CONSTRUCTION COSTS = $12,046.00



MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59101 Ph (406) 248-6088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: WILLOW CREEK ROAD RXR SHORT TERM IMPROVEMENTS	Sheet No. 1 of

SITE #9

OLD U.S. 93
PRIORITY NUMBER 9

SITE DESCRIPTION

Old U.S. 93 is a rural road on the old alignment of U.S. Highway 93 which is located just north of Florence, Montana. It begins at the Missoula County at an intersection with Highway 93 and proceeds south 1.7 miles to another intersection with Highway 93 at Florence. It provides access to farms and rural residences along its length.

The accident cluster area begins at the Missoula County line and extends 0.5 miles to the south.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accidents have occurred primarily on slight horizontal and vertical curves and near an intersection with Wagner Lane, an access road coming from the west. The roadway has 24 foot wide pavement and has variable shoulder widths and ditch slopes. It was built to old primary highway standards. Grades are fairly flat (0-4%) with numerous vertical curves. The roadside environment is not heavily forested. Trees along the roadway are sparse but some of them do hang foliage in the roadway.

Traffic Control Devices. The only traffic control devices

are speed limit signs (35mph) and information signs (County line). Pavement markings are present and are in fair shape.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 870 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4%. County counts were not available for this site. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. No serious potential operations problems were observed on this section of roadway during the field review. From the Engineer's perspective during subjective evaluations at the site, it was noted that several factors could likely combined to create potential problems.

1. A sag vertical curve just north of the Wagner Lane intersection has a blind spot. This area is marked for no passing but there are approach within the operational limits of this area.

2. There are sight distance restrictions at the Wagner Lane intersection caused by a tree and other vegetation. Gravel for Wagner Lane is also kicked onto the main road surface which would cause control problems in the intersection.

3. The speed limit is probably set too low considering the average speed of vehicles on this road.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were five accidents recorded in the four year study period. The accidents seem to be erratic with 1 occurring in 1985 and 1986 and 3 in 1987. The type of accidents were primarily single vehicle accidents with one rearend accident.

All of the accidents occurred in fair weather conditions on dry roads. Accidents occurred predominantly during the night time hours. The severity of accidents at this site is not too bad with with only 20% of the accidents producing injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. The night time accidents indicates that there is a problem with roadway alignment perception. The entire length of the site should be delineated to provide the necessary information. Advanced warning signs for the Wagner Lane intersection with supplementary name plates will help motorist locate and plan their turn and warn thru traffic that vehicles could be entering the roadway. Removal of the tree at the Wagner Lane approach will provide more sight distance. Also, paving of the approach road for a short distance will help keep gravel off of the paved surface.

The cost of these improvements is estimated to be approximately $3,570 based on 1989 unit bid contract prices and MDOH fund eligible prices. The paving should be much less if

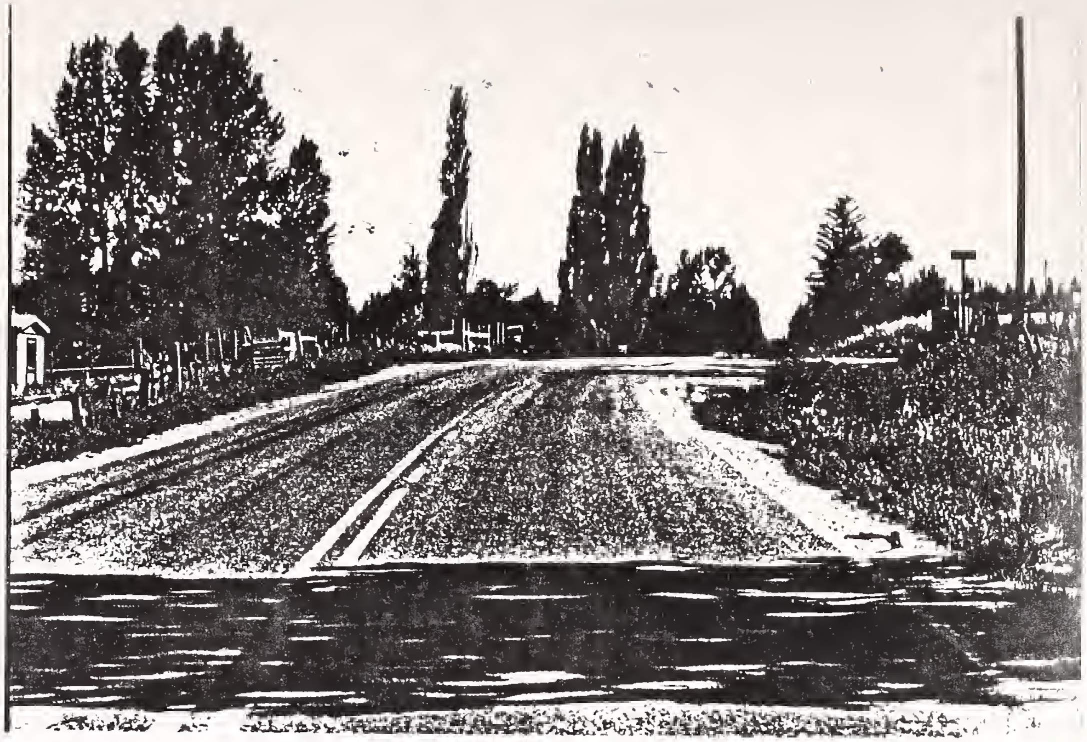
county crews performed the work.

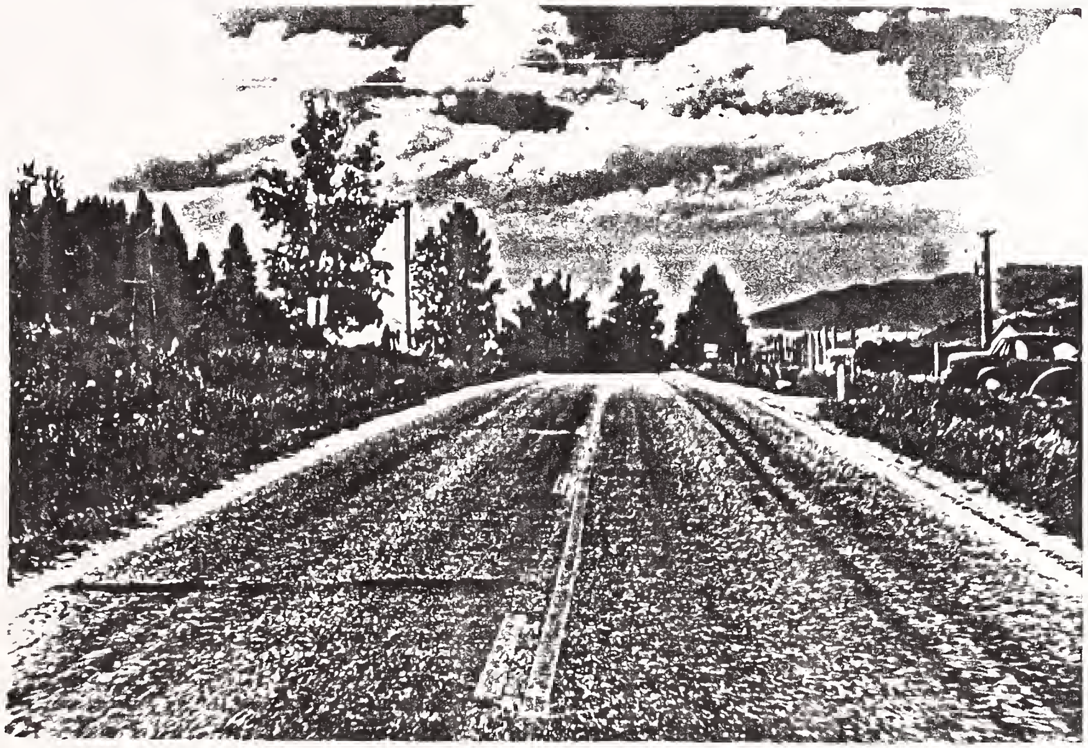
Long term improvements at this site are highly dependent on traffic growth. When traffic volumes reach the 2,000 - 3,000 ADT level, major reconstruction may be considered.

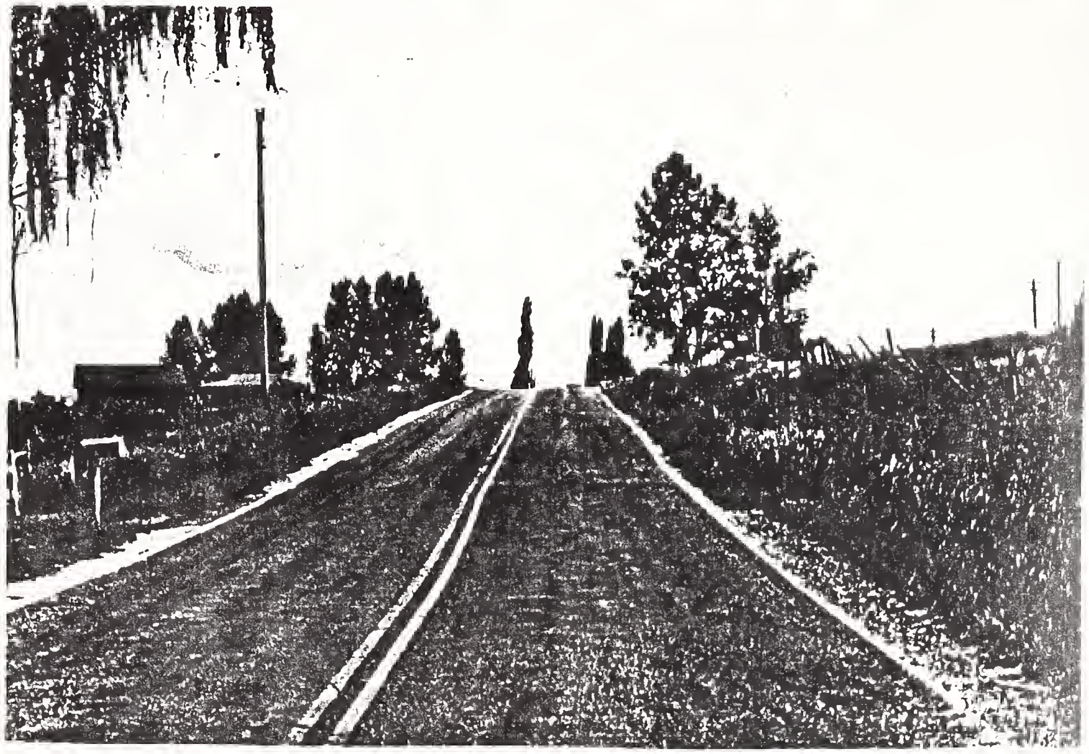
BENEFITS

The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $4,177 annually. The benefit/cost ratio is computed according to accepted methods at 4.21, which makes it a good investment for the economy of Ravalli County.

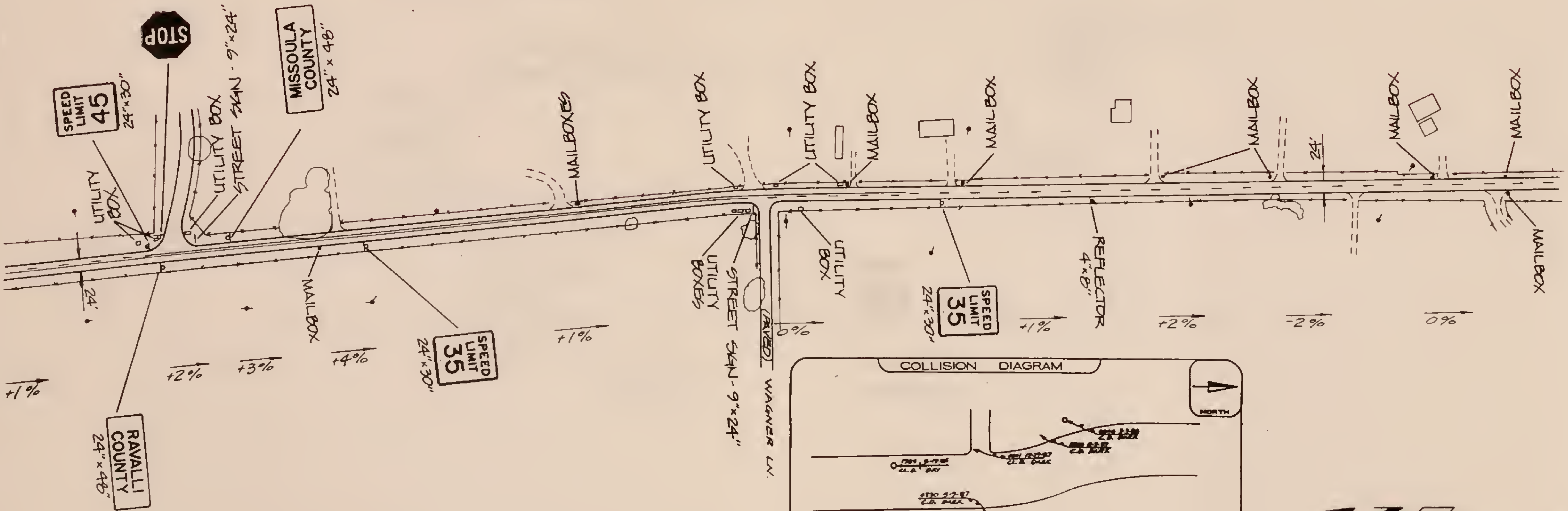

OLD US 93 @ WAGNER LANE, NORTHBOUND

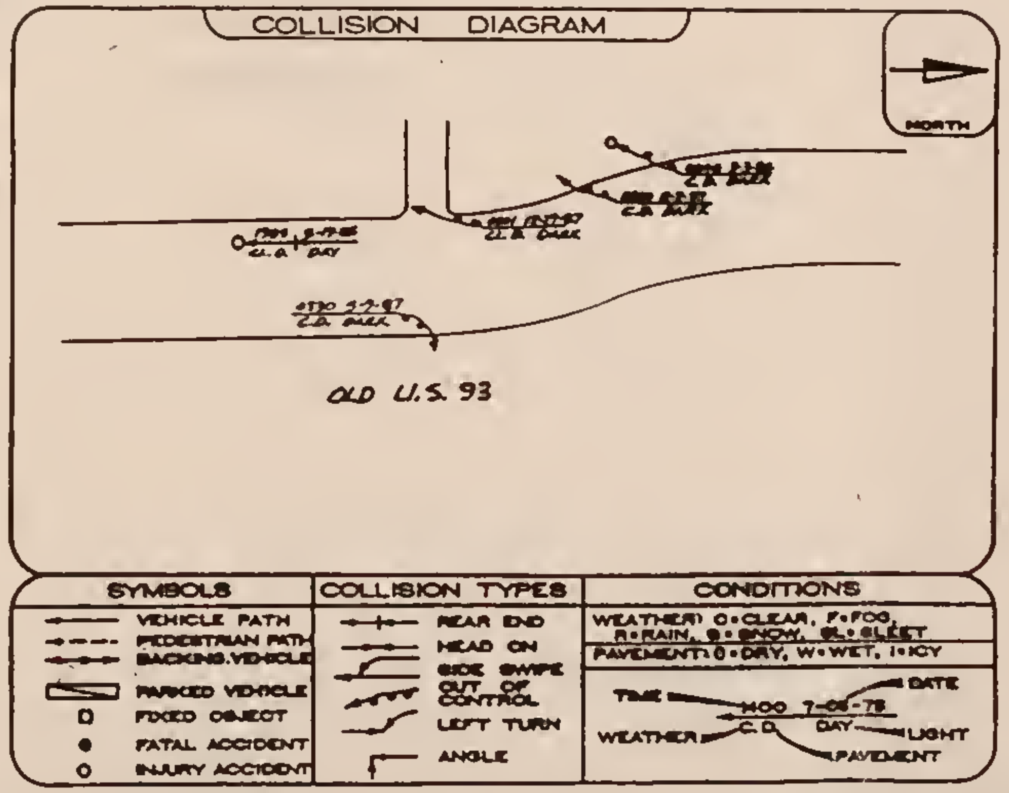

OLD US 93 @ WAGNER LANE SOUTHBOUND


OLD US 93 MID SITE, NORTHBOUND


OLD US 93 JUST S OF US 93, SOUTHBOUND

ACCIDENT STATISTICS - OLD U.S. 93	
ACCIDENTS / YEAR :	ROAD CONDITIONS - % OF TOTAL :
1985 = 1	5 DRY = 100%
1986 = 1	0 WET = 0%
1987 = 3	0 ICY = 0%
1988 = 0 TOTAL = 5	LIGHT CONDITIONS - % OF TOTAL :
ACCIDENT TYPE - % OF TOTAL :	4 DARK = 80%
0 HEAD ON = 0%	1 DAY = 20%
0 ANGLE = 0%	
0 LEFT TURN= 0%	SEVERITY - % OF TOTAL :
0 SIDE SWP.= 0%	0 FATAL = 0%
1 REAR END = 20%	1 INJURY = 20%
4 SINGLE V = 80%	4 PROP DAM= 80%
0 OTHER = 0%	
WEATHER CONDITIONS - % OF TOTAL :	ALCOHOL 2
5 CLEAR = 100%	INVOLVED
0 RAIN = 0%	% TOTAL = 40%
0 SNOW = 0%	
0 FOG = 0%	





SCALE: 1"=200'

MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph (406) 248-5088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: OLD U.S. 93 EXISTING CONDITIONS	Surveyed By: Designed By: Drawn By: Checked By: Date:	Revisions No. Date No. Date No. Date No. Date	Project No. Client No.	Sheet No. 1 of

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : OLD U.S. 93

ACCIDENT TYPE	# ACC. IN PERIOD I/F	# ACC. IN PERIOD PD	EST. % CHANGE	CHANGE IN # ACC. I/F	CHANGE IN # ACC. PD
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	1	0	40%	0.4	0.0
SINGLE VEHICLE	0	4	20%	0.0	0.8
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	1	4	***	0.4	0.8

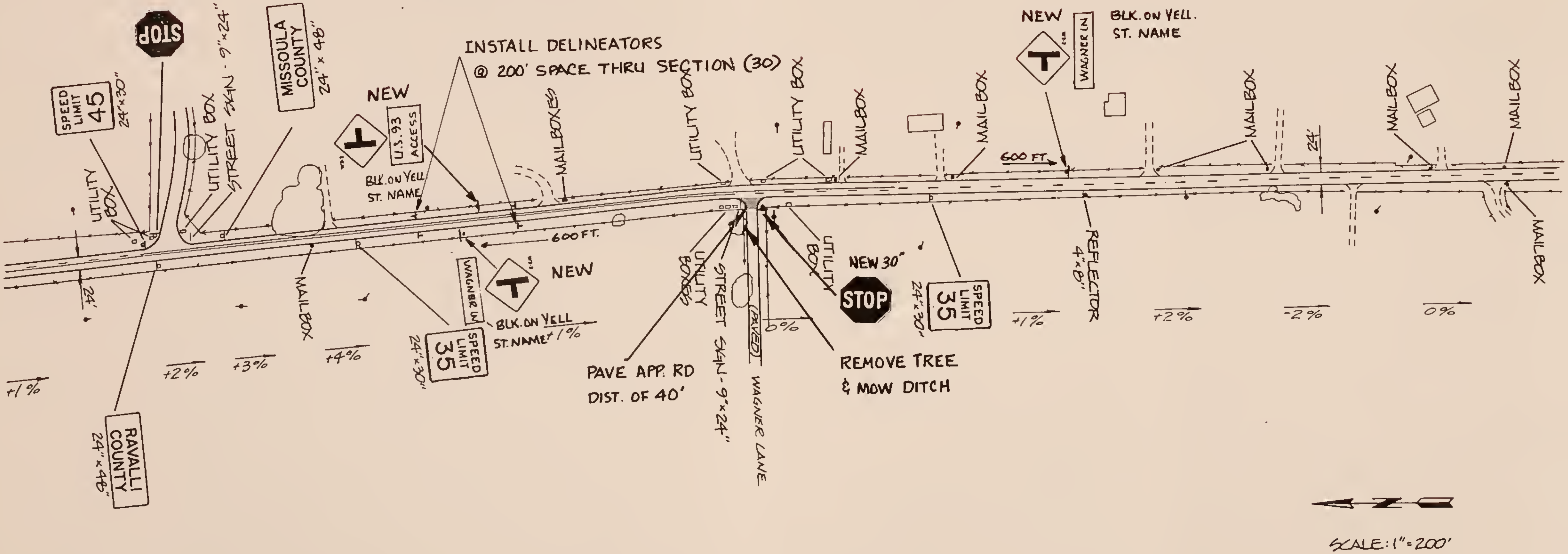
% REDUCTION IN INJURY/FATAL ACCIDENTS = 40.0%
% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 20.0%

OLD U.S. 93

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (<6 SF)	1	Ea	$100.00	$100.00
2	NEW SIGNS (6.1 TO 10 SF)	3	Ea	$140.00	$420.00
1	NEW SUPPLEMENTARY SIGNS	3	Ea	$50.00	$150.00
2	RELOCATE SIGNS	0	Ea	$40.00	$0.00
3	REMOVE SIGNS	0	Ea	$20.00	$0.00
4	PAVE. MARKINGS (PAINT)	0	Gal	$30.00	$0.00
5	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
6	DELINEATORS, FLEXIBLE	30	Ea	$20.00	$600.00
7	TRIM TREES	1	LS	$500.00	$500.00
8	APPROACH PAVING	1	LS	$1,800.00	$1,800.00

TOTAL CONSTRUCTION COSTS = $3,570.00



MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-6088

Project : RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title : OLD U.S. 93 SHORT TERM IMPROVEMENTS

Surveyed By :
Designed By :
Drawn By :
Checked By :
Date :

Revisions
No. ___ Date ___
No. ___ Date ___
No. ___ Date ___
No. ___ Date ___

Project No.

Chart No.

Sheet No. 1 of ___

SITE

10

MIDDLE BURNT FORK CREEK ROAD
PRIORITY NUMBER 10

SITE DESCRIPTION

Middle Burnt Fork Creek Road is a rural road which is located west of Stevensville. It provides access to farms, rural residences and forested areas east of the site. It begins in Stevensville at an intersection with the Eastside Highway and proceeds due east approximately 4.2 miles. At that point it heads southeast for approximately 13 miles into the Bitteroot National Forest.

The accident cluster area begins approximately 4.2 miles east of the intersection with the Eastside Highway and extends 1.2 miles to the southeast.

EXISTING CONDITIONS

Geometrics. The site geometrics are shown in the existing condition sketch. Accident cluster areas are located primarily on the curved sections of roadway. The roadway has 24 foot wide pavement surface and has variable shoulder widths and ditch slopes. The alignment of the road on both sides of the cluster area includes extended tangent sections. The cluster area is a series of simple, broken back and reverse curves. Grades through this section are relatively flat.

The roadside environment has a great deal of vegetation, mostly deciduous trees that hang into and over the roadway. There are

several driveway approaches and one road approach in the middle of a curve.

Traffic Control Devices. There are several types of traffic control devices along the roadway site. Hazard markers, curve warning signs, curve chevrons and weight limit signs. Apparently an attempt was made to warn drivers of the curve conditions was made in the recent past by installing the warning signs in the most hazardous of the site's curves. No pavement markings are visible in the area.

Traffic Volumes. The current traffic volume on this section of roadway is approximately 300 vehicles per day. Traffic volumes throughout the past four years have probably increased by approximately 4%. County counts for this site were not available. The directional split on this roadway is approximately 40%-60% which means that at certain periods of the day, 40% of the vehicles are going in one direction while the remainder are headed in the other.

Traffic Operations. Some serious potential operations problems were observed on this section of roadway during the field review. Also, from the Engineer's perspective during subjective evaluations at the site, it was noted that several factors could combine to create potential problems at this site.

1. The road approach from the east, toward the west end of the site, is completely obscured from view by roadside vegetation.

The approach has a 6-7% downgrade onto the pavement and gravel from the approach road is piled on the pavement surface.

2. The curves vary greatly in length and in degree of curvature which makes it very difficult for a driver to anticipate speed and distance on the curves.

3. Vegetation growth near and on the roadway obstructs the line of sight and causes drivers to shy away from the shoulders, effecting a one lane road in some areas.

Accidents. The collision diagram and accident statistics tables shown on the existing condition sketch indicates that there were six accidents recorded in the four year study period. The accidents were constant with 2 in each year of 1985,86 and 87. No accidents occurred in 1988. All of the accidents were single vehicle accidents.

The majority of accidents occurred in fair weather conditions and on dry roads. Accidents occurred predominantly during the night time hours. The severity of accidents at this site is fairly low considering the type of vehicles and speeds involved. Only 17% of the accidents produced injuries.

SHORT TERM IMPROVEMENTS

Suggested improvements at this site strive to reduce the effects of the above noted problems. Over sized curve warning signs are considered necessary in advance of the curves to provide adequate warning of the unexpected conditions. The

eastern most set of curves warrant a reverse curve sign, but the degree of curvature for each curve is so different, that it is necessary to sign each curve separately. Proper delineation of the roadway path is especially critical at this site. Pavement markings combined with delineators will provide adequate visual clues as to the proper vehicle path.

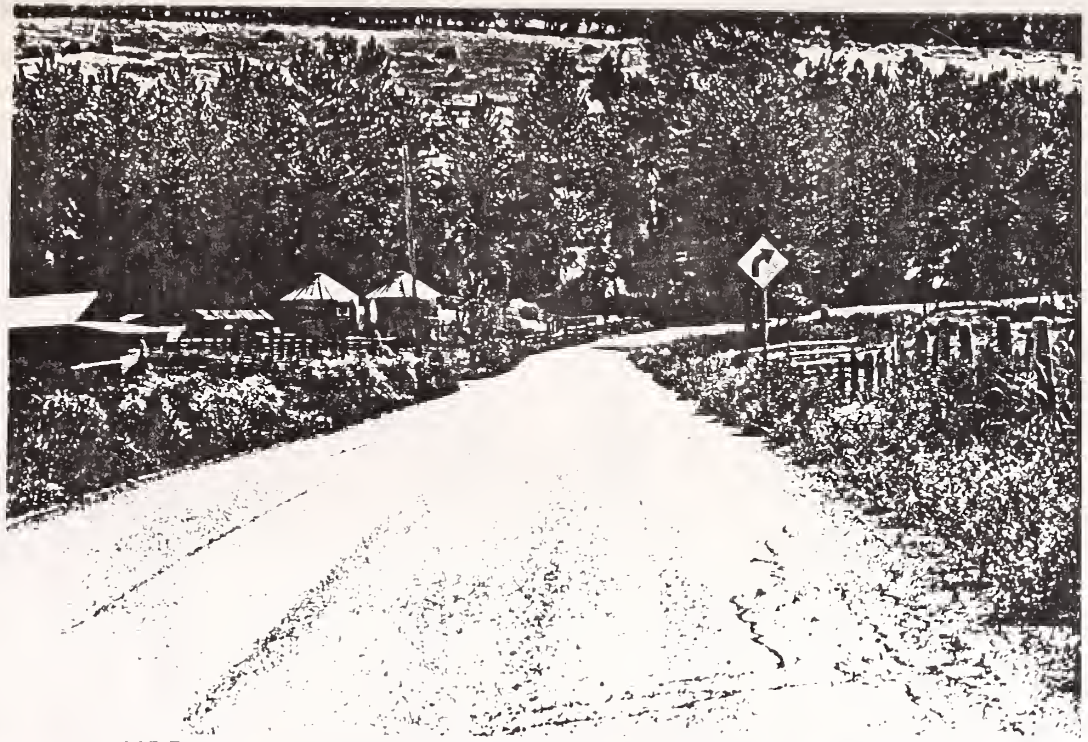
Removal of the trees and realigning and paving of the approach road should remove a very serious conflict problem area. Use of the advanced intersection warning signs will greatly aid drivers in recognizing the location of the approach. A stop sign should be placed on the side road to control right of way at the intersection.

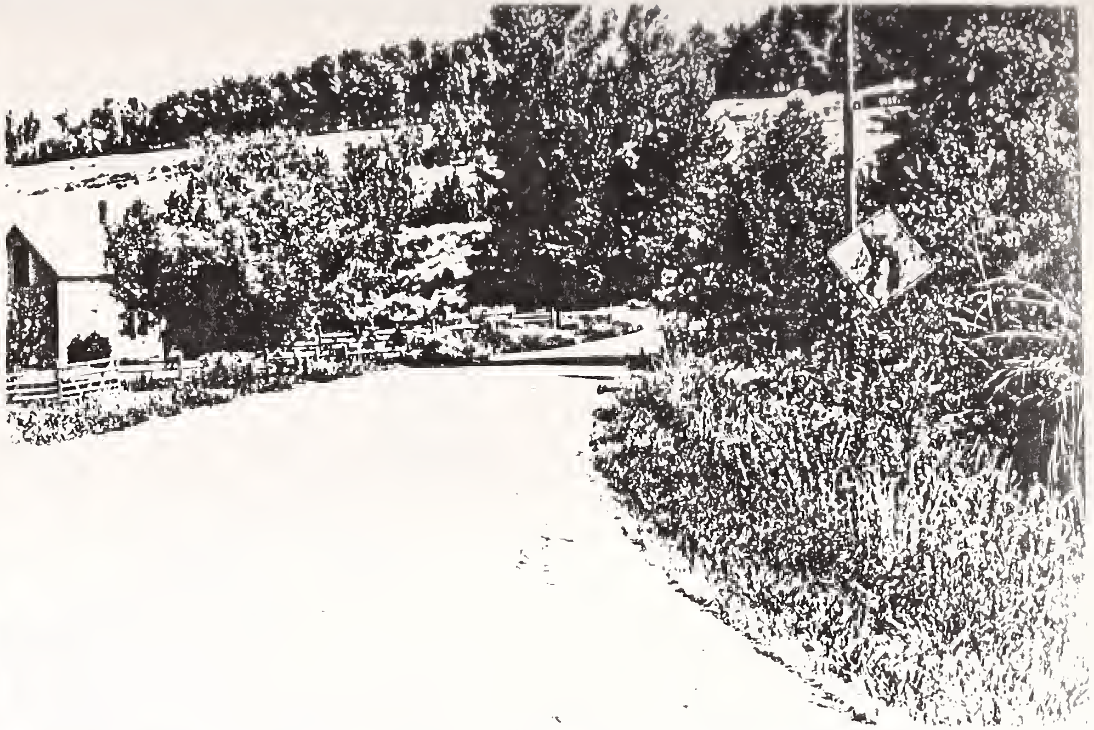
The cost of these improvements is estimated to be approximately $11,040 based on 1989 unit bid contract prices and MDOH fund eligible prices. The grading and pavement markings should be much less if county crews performed the work and the striping were to be completed as part of a county wide pavement marking program.

Long term improvements at this site could not be foreseen until there is an appreciably increase in traffic volumes.

BENEFITS

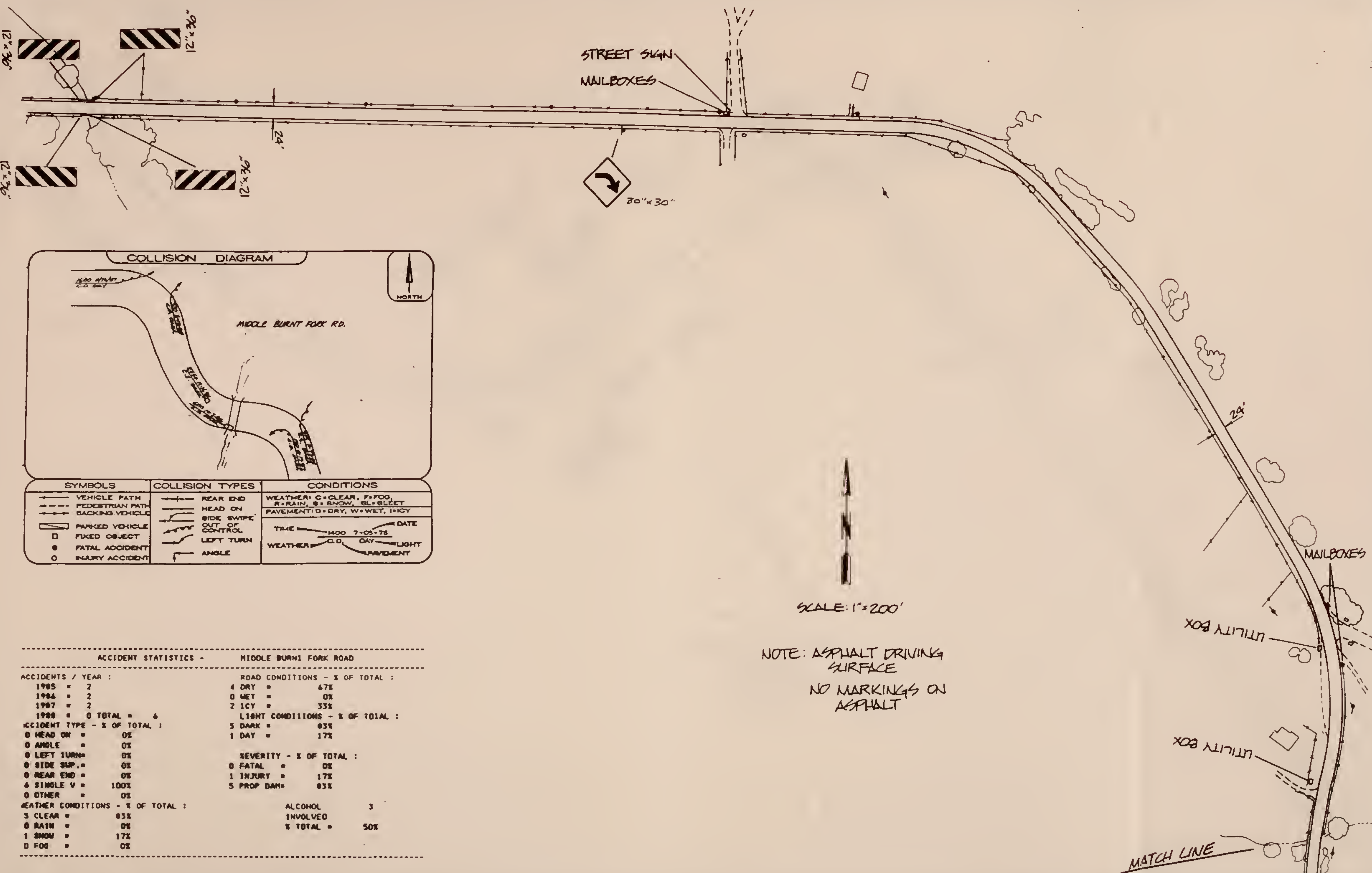
The annual dollar benefit that may be realized from the short term improvements is computed to be approximately $4,645 annually. The benefit/cost ratio is computed according to accepted methods at 1.57, which is the lowest of all the sites, but still cost effective.


MIDDLE BURNT FORK RD 1ST CURVE, EASTBOUND


MIDDLE BURNT FORK RD .5 MILE S, NORTHBOUND


MIDDLE BURNT FORK RD .3 MILE S, SOUTHBOUND


MIDDLE BURNT FORK RD .6 MILE S, SOUTHBOUND



ACCIDENT STATISTICS - MIDDLE BURNT FORK ROAD

ACCIDENTS / YEAR :
1985 = 2
1986 = 2
1987 = 2
1988 = 0 TOTAL = 6

ACCIDENT TYPE - % OF TOTAL :
0 HEAD ON = 0%
0 ANGLE = 0%
0 LEFT TURN= 0%
0 SIDE SWP.= 0%
0 REAR END = 0%
6 SINGLE V = 100%
0 OTHER = 0%

WEATHER CONDITIONS - % OF TOTAL :
5 CLEAR = 83%
0 RAIN = 0%
1 SNOW = 17%
0 FOG = 0%

ROAD CONDITIONS - % OF TOTAL :
4 DRY = 67%
0 WET = 0%
2 ICY = 33%

LIGHT CONDITIONS - % OF TOTAL :
5 DARK = 83%
1 DAY = 17%

SEVERITY - % OF TOTAL :
0 FATAL = 0%
1 INJURY = 17%
5 PROP DAM= 83%

ALCOHOL INVOLVED 3
% TOTAL = 50%

MARVIN & ASSOCIATES
Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph (406) 248-5088

Project :
RAVALLI COUNTY
TRAFFIC SAFETY STUDY

Sheet Title :
MIDDLE BURNT FORK ROAD
EXISTING CONDITIONS

Surveyed By :
Designed By :
Drawn By
Checked By :
Date

Revisions
No. Date
No. Date
No. Date
No. Date

Project No.
Client No.

Sheet No.
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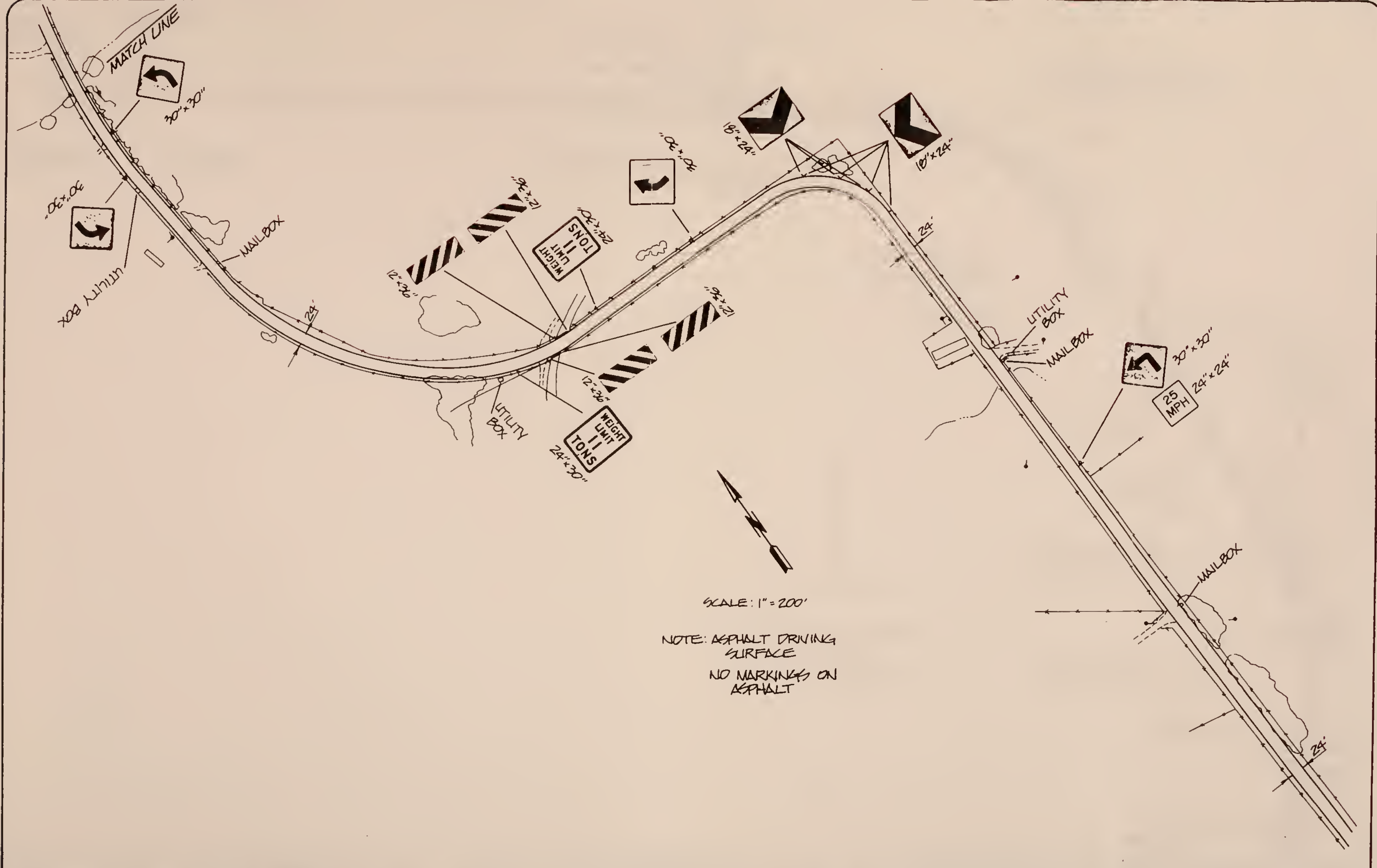
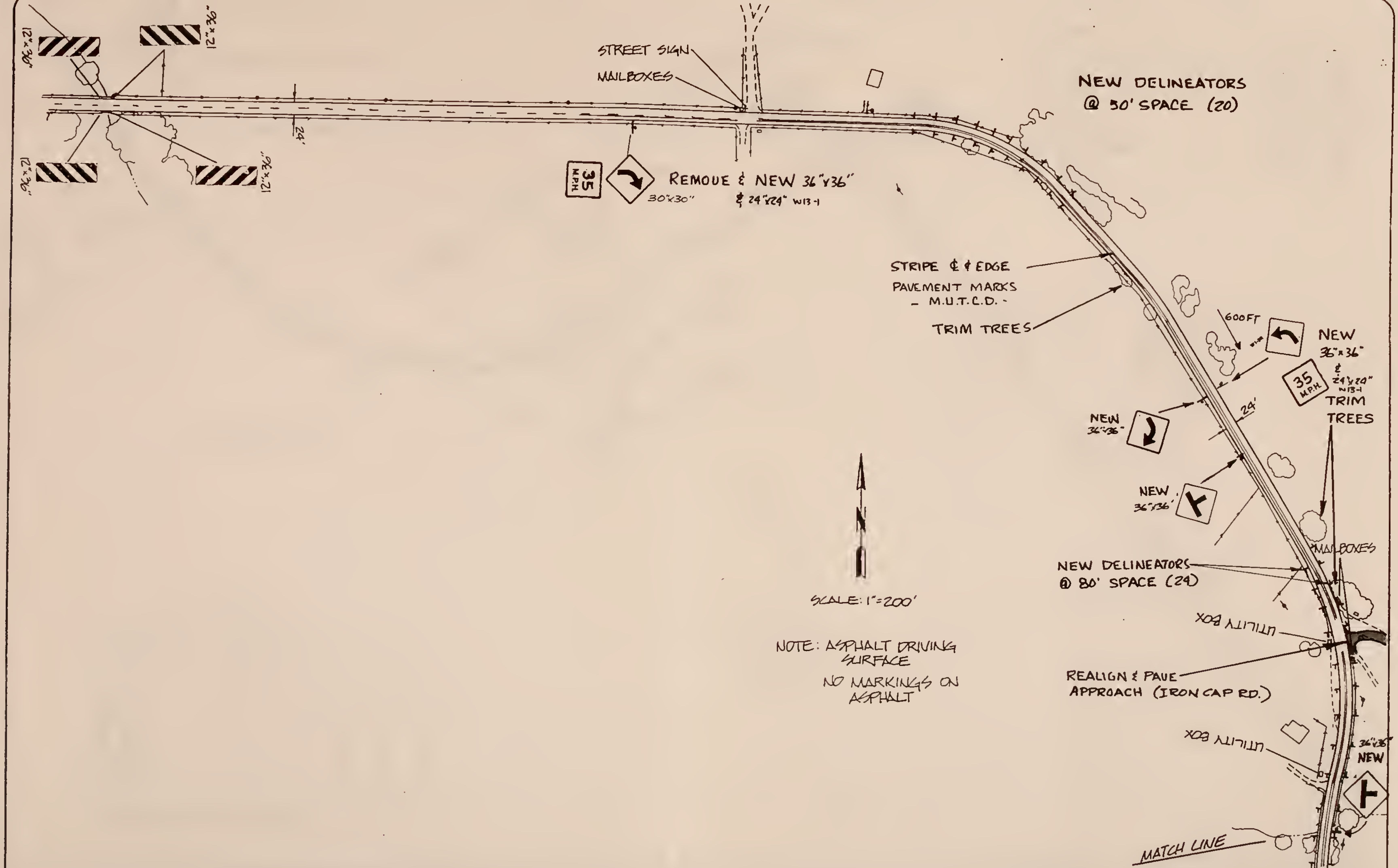
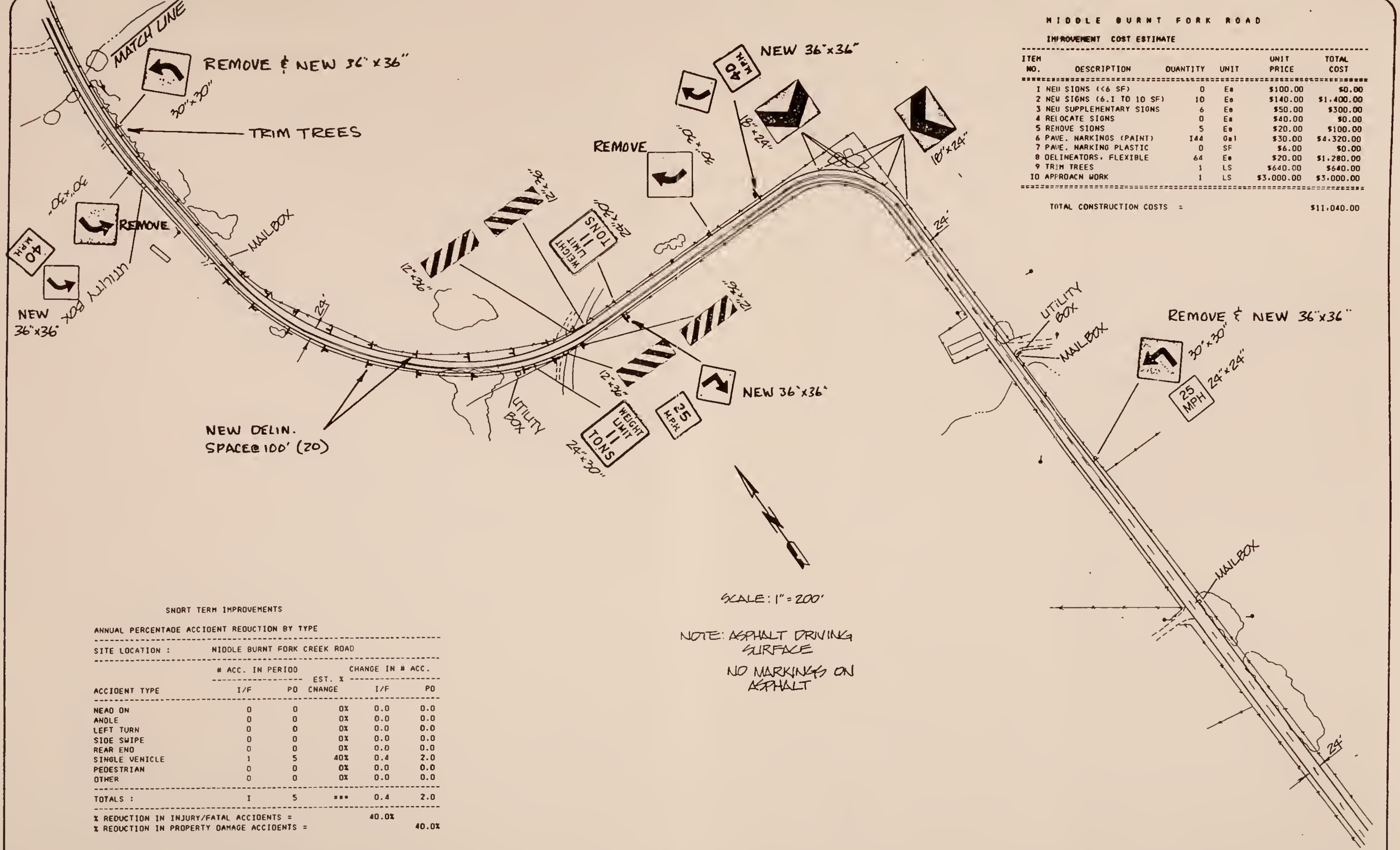
of



MARVIN &ASSOCIATES Traffic Transportation & Civil Engineers	SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph. (406) 248-5088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: MIDDLE BURNT FORK ROAD EXISTING CONDITIONS	Surveyed By: Designed By: Drawn By: Checked By: Date:	Revisions No. Date No. Date No. Date No. Date	Project No. Card No.	Sheet No. 2 of



MARVIN & ASSOCIATES Traffic Transportation & Civil Engineers SUITE 304 TRANSWESTERN I 404 N. 31st BILLINGS, MT 59107 Ph (406) 248-5088	Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY	Sheet Title: MIDDLE BURNT FORK ROAD SHORT TERM IMPROVEMENTS	Surveyed By: Designed By: Drawn By: Checked By: Date:	Revisions No. Date No. Date No. Date No. Date	Project No. Client No.	Sheet No. 1 of



MIDDLE BURNT FORK ROAD

IMPROVEMENT COST ESTIMATE

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
1	NEW SIGNS (<6 SF)	0	Ea	$100.00	$0.00
2	NEW SIGNS (6.1 TO 10 SF)	10	Ea	$140.00	$1,400.00
3	NEW SUPPLEMENTARY SIGNS	6	Ea	$50.00	$300.00
4	RELOCATE SIGNS	0	Ea	$40.00	$0.00
5	REMOVE SIGNS	5	Ea	$20.00	$100.00
6	PAVE. MARKINGS (PAINT)	144	Gal	$30.00	$4,320.00
7	PAVE. MARKING PLASTIC	0	SF	$6.00	$0.00
8	DELINEATORS, FLEXIBLE	64	Ea	$20.00	$1,280.00
9	TRIM TREES	1	LS	$640.00	$640.00
10	APPROACH WORK	1	LS	$3,000.00	$3,000.00

TOTAL CONSTRUCTION COSTS = $11,040.00

SHORT TERM IMPROVEMENTS

ANNUAL PERCENTAGE ACCIDENT REDUCTION BY TYPE

SITE LOCATION : MIDDLE BURNT FORK CREEK ROAD

	# ACC. IN PERIOD		EST. %	CHANGE IN # ACC.	
ACCIDENT TYPE	I/F	PD	CHANGE	I/F	PD
HEAD ON	0	0	0%	0.0	0.0
ANGLE	0	0	0%	0.0	0.0
LEFT TURN	0	0	0%	0.0	0.0
SIDE SWIPE	0	0	0%	0.0	0.0
REAR END	0	0	0%	0.0	0.0
SINGLE VEHICLE	1	5	40%	0.4	2.0
PEDESTRIAN	0	0	0%	0.0	0.0
OTHER	0	0	0%	0.0	0.0
TOTALS :	1	5	***	0.4	2.0

% REDUCTION IN INJURY/FATAL ACCIDENTS = 40.0%
% REDUCTION IN PROPERTY DAMAGE ACCIDENTS = 40.0%

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Traffic Transportation & Civil Engineers
SUITE 304 TRANSWESTERN I
404 N. 31st
BILLINGS, MT 59107
Ph. (406) 248-5088

Project: RAVALLI COUNTY TRAFFIC SAFETY STUDY

Sheet Title: MIDDLE BURNT FORK ROAD SHORT TERM IMPROVEMENTS

Surveyed By:
Designed By:
Drawn By:
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